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THE ECONOMIC OUTLOOK—PRESENT AND PROSPECTIVE.

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PART III.

ATTENTION is next asked to the *second* (assumed) cause for the prevailing discontent of labor, namely:

Changes in the character or nature of employments consequent upon the introduction of new methods—machinery or processes—which it is claimed have tended to lower the grade of labor, impair the independence, and restrict the mental development of the laborer.

That such changes have been in the nature of evil, can not be questioned; but they are not new in character, nor as extensive in number and effect as is popularly supposed. Subordination to routine and method is an essential element in all systematized occupations; and in not a few employments and professions—as in all military and naval life, and in navigation and railroad work—an almost complete surrender of the independence of the individual, and an unreasoning mechanical compliance with rules or orders, are the indispensable conditions for the attainment of any degree of successful effort. In very many cases also the individual finds compensation for subordination and the surrender of independence in the recognition that such conditions may be but temporary, and are the necessary antecedents for promotion; and routine and monotony are doubtless in a greater or less degree alleviated when the operative can discern the plan of his work as an entirety, and note its result in the form of finished products. But in manufacturing operations, where the division of labor has been carried to an extreme;

where the product of the worker is never more than a fraction of any finished "whole," and where no greater demand is made upon the brain than that it shall see that the muscles of the arm, the hand, or the finger execute movements at specific times and continuously in connection with machinery, there are few such compensations or alleviations; and the general result to the individual working under such conditions can not, to say the least, be in the line of either healthy mental or physical development. Happily, however, the number of industries, in which division of labor and its subordination to machinery has been productive of such extreme results, is not very large; the manufacture of boots and shoes by modern machine methods, in which every finished shoe is said to represent sixty-two distinct mechanical employments or products, being perhaps the most notable. And yet even here there is not a little in way of compensating benefit to be credited to such a system. Thus, for example, it is stated that "the use of machinery has compelled employés to apply themselves more closely to their work; and, being paid by the piece, has enabled them to make better wages." When shoemaking was a handicraft, "the hours of labor were very irregular; the workmen, who decided their own hours of labor, working some days only a few hours, and then working far into the night for a few days to make up for lost time. It was once customary for shoemakers (in New England) to work on an average fifteen hours a day;" now the hours of labor in the shoe-factories are not in excess of ten hours. It is also claimed that the introduction of the sewing-machine into the manufacture of boots and shoes has greatly increased the opportunities for the employment of women, at better rates of wages. In the manufacture of clothing, which, in routine and monotony, is analogous to the manufacture of boots and shoes, it is generally conceded that the influence of the sewing-machine has been to increase wages, and that "notwithstanding the constantly growing use of these machines, the number of employés is greater than formerly, owing to the enlargement of the business." * Furthermore, the "collective work which admits of being carried on by the factory principle of great subdivision of labor and by the bringing together of large numbers of people under one roof and one control" does not at present, in the United States, give occupation to more than one in ten of all who follow gainful occupations in the whole country; while for the other nine the essential elements of industrial success continue, as of old, to be found in individual independence and personal mental capacity; and this experience of the United States will probably find a parallel in all other manufacturing countries.

* "Report on the Statistics of Wages," J. D. Weeks, U. S. Census, vol. xx.

The supersedure of men by women and young persons in textile manufactories, which (as previously noticed) has occurred to such an extent in New England that certain factory towns have come to be popularly designated as "she-towns," at first thought seems deplorable. But, on the other hand, it is certain that such supersedure has been mainly the result of such a diminution of the severity of toil through the improvements in machinery, or such a greater division of labor consequent upon new methods of production, as have opened up new opportunities for employment to women, by making it possible for them to do easily work which, under old systems, required the greater strength and endurance of men; children, for example, being able to spin yarn on a "ring-frame," which men alone were able to do on a "spinning-mule." And, however such changes may be regarded from the standpoint of the male operatives, the greater opportunity afforded for continuous work at higher wages than could be readily obtained in other occupations, is probably not regarded by the women in the light of a misfortune. Experience also shows that the larger the scale on which capitalistic production and distribution is carried on, "the less it can countenance the petty devices for swindling and pilfering," and the neglect and disregard of the health, safety, and comfort of operatives, which so frequently characterize industrial enterprises on a small scale; or, in other words, the maintenance of a high standard of industrial and commercial morality is coming to be recognized by the managers of all great enterprises as a means of saving time and avoiding trouble, and therefore as an undoubted and important element of profit. And it is to these facts—the natural and necessary growth of what has been termed the "capitalistic system"—that a recent English writer on the condition of the working-classes, largely attributes the suppression of the truck (store) system, the enactment of laws limiting the hours of labor, the acquiescence in the existence and power of trade-unions, and the increasing attention to sanitary regulations; reforms that have reformed away the worst features of the condition of labor as it existed thirty or forty years ago in Great Britain.* The larger the concern, the greater usually the steadiness of employment, and the more influential the public opinion of the employed.

Dr. Werner Siemens, the celebrated German scientist and inventor, in a recent address at Berlin on "Science and the Labor Question," claimed that the necessity for extensive factories and workshops—involving large capital and an almost "slavish" discipline for labor—to secure the maximum cheapness in pro-

* "The Condition of the Working Class in England in 1844," by Frederick Engles.

duction, "was due, to a great extent, to the yet imperfect development of the art of practical mechanics"; and that mechanical skill will ultimately effect "a return to the system (now almost extinct) of independent, self-sustaining domiciliary labor" by the introduction of cheap, compact, easily set up and operated labor-saving machinery into the smaller workshops and the homes of the workingmen. Should the difficulties now attendant upon the transmission of electricity from points where it can be cheaply generated, and its safe and effective subdivision and distribution as a motive force, be overcome (as it is not improbable they ultimately will be), thus doing away with the necessity of multiplying expensive and cumbersome machinery —steam-engines, boilers, dams, reservoirs, and water-wheels— for the local generation and application of mechanical power, there can be no doubt that most radical changes in the use of power for manufacturing purposes will speedily follow, and that the anticipations of Dr. Siemens, as to the change in the relations of machinery to its operatives, may at no distant day be realized.

The third cause which has especially operated in recent years to occasion discontent on the part of labor has been undoubtedly *the increase in intelligence or general information on the part of the masses in all civilized countries.*

The best definition, or rather statement, of the essential difference between a man and an animal that has ever been given is, that a man has progressive wants, and an animal has not. Under the guidance of what is termed instinct, the animal wants the same habitat and quantity and quality of food as its progenitors, and nothing more. And the more nearly man approaches in condition to the animal, the more limited is the sphere of his wants, and the greater his contentment. A greater supply of blubber and skins to the Esquimaux, more "pulque" to the native Mexican, to the West Indian negro a constant supply of yams and plantains without labor, and the ability to buy five salt herring for the same price that he has now to give for three, would, in each case, temporarily fill the cup of individual happiness nearly to repletion. And, among civilized men, the contentment and also sluggishness of those neighborhoods in which the population come little in contact with the outer world and have little of diversity of employment open to them, are proverbial. Now the wonderful material progress which has been made within the last quarter of a century has probably done more to overcome the inertia, and quicken the energy of the masses, than all that has been hitherto achieved in this direction in all preceding centuries. The railroad, the steamship, and the telegraph have broken down the barriers of space and time that

formerly constituted almost insuperable obstacles in the way of frequent intercourse between people of different races, countries, and communities, and have made the civilized world, as it were, one great neighborhood. Every increased facility that is afforded for the dissemination of intelligence, or for personal movement, finds a marvelously quick response in an extended use. The written correspondence—letters and cards—exchanged through the world's postal service, more than doubled between the years 1873 and 1885; while in the United States the number of people annually transported on railroads alone exceeds every year many times the total population of the country; the annual number for the New England States being more than sixteen times greater than their population. Under these powerful but natural educating influences, there has been a great advance in the intelligence of the masses. They have come to know more of what others are doing; know better what they themselves are capable of; and their wants have correspondingly increased, not merely in respect to quantities of the things to which they have always been accustomed, but very many articles and services which within a comparatively recent period were regarded as luxuries, are now almost universally considered and demanded as necessities. At the same time, the increased power of production and distribution, and the consequent reduction in the cost of most commodities and services, have also worked for the satisfaction of these wants in such a degree that a complete revolution has been effected during recent years in the every-day life of all classes of the people of the great industrial and commercial countries. Let any one compare the condition of even the abject poor of London, as described in recent publications, with the condition of English laborers as described by writers of acknowledged authority not more than forty years ago,* and he can not resist the conclusion that the very outcasts of England are now better provided for than were multitudes of her common laboring-men at the period mentioned.

But the widening of the sphere of one's surroundings, and a larger acquaintance with other men and their pursuits, have long been recognized as not productive of content.† Writing to his nephew a hundred years ago, Thomas Jefferson thus concisely

* The condition of agricultural laborers in general, and large classes of artisans, in the United Kingdom, forty or fifty years ago, as described by Carlyle in his "Past and Present" and "Sartor Resartus," and by another most reliable English authority, Mr. W. T. Thornton, in his "Overpopulation and its Remedy," was so deplorable that it is now difficult to realize that it ever existed.

† Increased facility for communication between Great Britain and the United States has without doubt been a large factor in occasioning the present profound discontent of Ireland; and political subjugation and their existing land system have been more intolerable to the Irish peasant and artisan, since they have been enabled to compare the in-

expressed the results of his own observation: "Traveling," he says, "makes men wiser, but less happy. When men of sober age travel they gather knowledge, but they are, after all, subject to recollections mixed with regret; their affections are weakened by being extended over more objects, and they learn new habits which can not be gratified when they return home." Again, as the former few and simple requirements of the masses have become more varied and costly, the individual effort necessary for the satisfaction of the latter is not relatively less, even under the new conditions of production, than before, and in many instances is possibly greater. Hence, notwithstanding the large advance in recent years in the average rates of wages, and their increased purchasing power, there is no less complaint than formerly of the cost of living; when (as M. Leroy-Beaulieu has pointed out in the case of France*) the foundation for the complaint is for the most part to be found in the circumstance that a totally different style of living has been adopted, and that society makes conformity with such different style a standard of family respectability.

There is, therefore, unquestionably in these facts an explanation of what to many has seemed one of the greatest puzzles of the times, namely, that with greater and increasing abundance and cheapness of most desirable things, popular discontent with the existing economic condition of affairs does not seem to diminish, but rather to greatly increase. And out of such discontent, which is not based on anything akin to actual and unavoidable poverty, has originated a feeling that the new conditions of abundance should be further equalized by some other methods than intelligent individual effort, self-denial, and a natural, progressive material and social development,† and that the state

stitutions under which they live with those which their expatriated fellow-countrymen enjoy elsewhere.

* "The Fall in the Price of Commodities: its Cause and Effect," by Leroy-Beaulieu. *Economiste français, April, 1887.*

† As it is important to make clear the full force and meaning of the term "self-denial" and "natural progressive material and social development," as above used, attention is asked to the following considerations: The investigations of Mr. Atkinson show that an increase of five cents' worth of material comfort per day, for every day in the year, to each inhabitant of the United States, would require the annual production and equitable distribution of more than $1,000,000,000 worth of commodities! In the last analysis, therefore, national prosperity and adversity are measurable by a difference which is not in excess of the price of a daily glass of beer; or, if five cents' worth of product for each inhabitant could be added to the capital of the country in excess of the average for each day in the year, such a year, by reason of its increased exchanges and sum of individual satisfactions, could not be other than most prosperous.

Again, the extraordinary and comparatively recent reductions in the cost of transportation of commodities by land and water (in the case of the New York Central and Hudson River Railroad, for example, from an average of 3·45 cents per ton per mile in 1865 to

could, if it would, make all men prosperous; and therefore should, in some way not yet clearly defined by anybody, arbitrarily intervene and effect it. And this feeling, so far as it assumes definiteness of idea and purpose, constitutes what is called "socialism." *

The following additional results—industrial and social—which have been attendant upon the world's recent material progress are also worthy of consideration by all desirous of fully comprehending the present economic situation, and the outlook for the future.

ADVANCE IN WAGES.—The average rate of wages, or the share which the laborer receives of product, has within a comparatively recent period, and in almost all countries—certainly in all civilized countries—greatly increased. The extent of this increase since 1850, and even since 1860, has undoubtedly exceeded that of any previous period of equal duration in the world's history.

Mr. Giffen claims as the result of his investigations for Great Britain, that "the average money-wages of the working-classes of the community, looking at them in the mass, and comparing the mass of *fifty* years ago with the mass at the present

0·68 of a cent in 1885), which have reduced the prices of the common articles of food to the masses to the extent of substantially one half, did not involve in their conception and carrying out any idea of benefiting humanity; but on the contrary those immediately concerned in effecting the improvements that have led to such results, never would have abated the rates to the public, but would have controlled and maintained them to their own profit, had they been able. But, by the force of agencies that have been above human control, they have not only not been able to do so, but have been constrained to promptly accept business at continually decreasing rates, as a condition of making any profit for themselves whatever. And what is true of the results of improvements in the transportation of products is equally true of all methods for economizing and facilitating their production. They are all factors in one great natural movement for continually increasing and equalizing abundance.

* On this point the Commissioner of the Bureau of Labor Statistics of the State of Connecticut, in his report for 1887, speaks as follows: "Necessary wants have multiplied, and society demands so much in the style of living that the laboring-man finds it almost impossible to live as respectably now on his wages as his father did thirty years since upon his. That is, wages have not kept pace with the increasing wants and style of living demanded by society. The laborer thinks he sees a wider difference between the style in which his employer lives and the way he is compelled to live, than existed between employer and employés thirty years ago. He thinks that this difference is growing greater with the years. Now, as a man's income is, in general, measured by his style of living, he can not resist the conclusion that a larger share of the profits of business goes to his employer than employers received in former years; that the incomes of employers have increased more rapidly than the wages of employés. The laboring people are fully alive to the fact that modern inventions and the like make larger incomes possible and right. They do not complain of these larger incomes, but they do believe most profoundly that they are not receiving their fair share of the benefits conferred upon society by these inventions and labor-saving machines. In this belief lies the principal source of their unrest."

time, have increased very nearly 100 per cent.* It is also conceded of this increase in Great Britain, that by far the largest proportion has occurred within the later years of this period, and has been concurrent with the larger introduction and use of machinery. Thus the investigations of Sir James Caird show that the advance in the average rate of wages for agricultural labor in England in the twenty-eight years between 1850 and 1878 was 45 per cent greater than the entire advance that took place in the eighty years next preceding 1850.

Mr. Giffen has also called attention to an exceedingly interesting and encouraging feature which has attended the recent improvement in money-wages in Great Britain—and which probably finds correspondence in other countries; and that is, that the tendency of the economic changes of the last fifty years has been not merely to augment the wages of the lowest class of labor, but also to reduce in a marked degree the proportion of this description of labor to the total mass—"its numbers having diminished on account of openings for labor in other directions. But this diminution has at the same time gone along with a steady improvement in the condition of the most unskilled laborers themselves." So that, if there had been no increase whatever in the average money-wages of Great Britain in recent years, the improvement in the general condition of the masses in that country "must have been enormous, for the simple reason that the population at the higher rate of wages has increased disproportionately to the others." But all this is only another way of proving that machinery always saves or minimizes the lowest and crudest kinds of labor. One of the most interesting and unquestionably one of the most accurate investigations respecting the change in wages since 1850, in the leading industries of Great Britain, was made in 1883 by Mr. George Lord, President of the Manchester (England) Chamber of Commerce. The results showed that the percentage increase in the average wages paid in eleven of the leading industries of that city between 1850 and 1883 was 40 per cent; the increase ranging from 10·30 per cent in mechanical engineering (fitters and turners) to 74·72 per cent in the case of other mechanics and in medium cotton spinning and weaving. In the United States, according to the data afforded by the census returns for 1850 and 1880, the average wages paid for the whole country increased

* This statement was first made by Mr. Giffen in 1883, in his inaugural address as President of the Royal Statistical Society of England, and was received with something of popular incredulity. But recurring to the same subject in another communication to the same society in 1886, Mr. Giffen asserts that further investigations show that there is no justification whatever for any doubts that may have been entertained as to the correctness of his assertions.

during the interval of these years by 39·9 per cent; or in a slightly smaller ratio of increase than was experienced during the same period in the industries of that district of England of which the city of Manchester is the center. The figures of the United States census of 1850 can not, however, be accepted with confidence.*

As respects agricultural labor in the United States, the assertion is probably warranted that, taking into account the hours of work, rates of wages, and the prices of commodities, the average farm-laborer is 100 per cent better off at the present time than he was thirty or forty years ago. In Massachusetts the average advance in the money-wages of this description of labor between 1850 and 1880 was 56 per cent, with board in addition. Between 1842 and 1846 the wages of agricultural labor in the United States sank to almost the lowest points of the century. According to the investigations of the Massachusetts Bureau of Labor Statistics, the average advance in general wages in that State from 1860 to 1883 was 28·36 per cent, while the conclusions of Mr. Atkinson are that the wages of mechanics in Massachusetts were 25 per cent more in 1885 than they were in 1860.

Taking the experience of the cities of St. Paul and Minneapolis as a basis, recent investigations also show a marked increase in the average wages of all descriptions of labor in the northwestern sections of the United States, comparing 1886 with 1875, of at least 10 per cent. In all railroad-work, the fact to which Mr. Giffen has called attention as a gratifying result of recent English experience also here reappears—namely, that the proportion of men earning the highest rates of wages is much greater than it was ten years ago, or more skilled workmen and fewer common workmen are relatively employed.

A series of official statistics, published in the "Annuaire statistique de la France," respecting the rates of wages paid in Paris and in the provinces of France in twenty-three leading industries during the years 1853 and 1883 respectively, show that, during the period referred to, the advance in average wages in Paris was 53 per cent and in the provinces 68 per cent, the figures being applicable to 1,497,000 workmen out of a total of 1,554,000 ascertained to be occupied in these industries by the French census of 1876.† M. Yves Guyot, the eminent French

* It is at the same time not a little significant that the Commissioner of the Massachusetts Bureau of Labor Statistics should have reported in 1884, as the result of his investigations, that while from 1872 to 1883 wages advanced on an average 9·74 per cent in Great Britain, they declined on the average in Massachusetts during the same period 5·41 per cent.

† "On the Comparative Efficiency and Earnings of Labor at Home and Abroad," by J. S. Jeans, "Journal of the Royal Statistical Society" (G. B.), December, 1884.

economist, is also the authority for the statement that the average daily wages of work-women in France engaged in the manufacture of clothing, lace, embroideries, laundry-work, and the like, increased 94 per cent between the years 1844 and 1872. In the cotton-mills at Mülhausen, Germany, the rates of increase in wages between 1835 and 1880 range between 60 and 256 per cent, the increase in the later years, as in other countries, having been particularly noticeable.

Accepting the wage statistics of France (and they are official), it would, therefore, appear that the rise of wages in that country during the years above reviewed was greater than was experienced in either England or the United States.

One factor which has undoubtedly contributed somewhat to the almost universal rise of wages during the last quarter of the century has been the immense progress that has been made in the abolition of human slavery—absolute, as well as in its modified forms of serfdom and peonage—which thirty years ago existed unimpaired over no inconsiderable areas of the earth's surface, and exerted a powerful influence for the degradation of labor and reduction of average wages to a minimum.

Relation of Wages to Living.—All conclusions as to the effect of changes in the rates of wages in any country are, however, incomplete, unless accompanied by data which permit of a conversion of wages into living, and these, in the case of the United States and for the period from 1860 to 1885, have been furnished by Mr. William M. Grosvenor, through a careful tabulation of the prices of two hundred commodities, embracing nearly all those in common use. From these comparisons it appears, that, if the purchasing power of one dollar in gold coin in May, 1860, be taken as the standard—or as one hundred cents' worth—the corresponding purchasing power of a like dollar in the year 1885 was 26·44 per cent greater. The artisan in Massachusetts in this latter year, therefore, could either "have largely raised the standard of his living, or, on the same standard, could have saved one third of his wages." Similar investigations instituted in Great Britain (and which had been before noticed) indicate corresponding results.

Another conclusion of Mr. Atkinson would also seem to be incapable of contravention, namely: That the greatly increased product of the fields, forests, factories, and mines of the United States which has occurred during the period from 1860 to 1885 "must have been mostly consumed by those who performed the actual work, because they constitute so large a proportion—substantially about ninety per cent—of the whole number of persons by whom such products are consumed," and that "no other evidence is needed to prove that the working man and woman of

the United States, in the strictest meaning of these words, are, decade by decade, securing to their own use and enjoyment an increasing share in a steadily increasing product." *

The report of the Bureau of Industrial Statistics of the State of Maine, for the year 1887, also presents some notable evidence of the continued increase in the purchasing power of wages; and show that, taking the experience of a typical American family in that State, deriving their living from manufacturing employments, as a basis, as much of food could be bought in 1887 for one dollar as would have cost $1.20 in 1882 and $1.30 in 1877; the difference being mainly due to reductions in the prices of flour, sugar, molasses, fresh meats, lard, oil, and soap.

In a paper presented to the British Association in 1886 by Mr. M. G. Mulhall, the increase in the purchasing power of money as respects commodities, and its decrease in purchasing power as respects labor in England during the period from 1880–'83 as compared with the period from 1821 to 1848, was thus illustrated by being reduced to figures and quantities: Thus in 1880–'83, 117 units of money would have bought as much of grain as 142 units could have done in 1821–'48; but, in respect to labor, it would have required 285 units of money to have bought as much in 1880–'83 as 201 units did in 1821–'48. In respect to cattle, the purchasing power of money had decreased in the ratio of 312 in the latter to 218 in the former period; but since 1879 the carcass price of meats has notably declined in England: inferior beef upon the London market to the extent of 43 per cent (in 1885–'86); prime beef, 18 per cent; pork, 22 per cent; middling mutton, 27 per cent. It is also undoubtedly true, as Mr. John Bright has recently pointed out,† that meat, in common with milk and butter, commands comparatively high prices in England, "because our people, by thousands of families, now eat meat who formerly rarely tasted it, and because our imports of these articles are not sufficient to keep prices at a more moderate rate."

One point of interest pertinent to this discussion, which has for some time attracted the attention of students of social science in England and France, has also been made a matter of comment in the cities of the northwestern United States, especially in St. Paul and Minneapolis, and is probably applicable to all other sections of the country; and that is, that expenditures for rent form at present a much larger item in the living expenses of families than ever before, and for the reason that people are no longer content to live in the same classes of houses as formerly; but demand houses with all of the so-called modern improvements—gas and water and better warming, ventilating, and sanitary arrangements—which must be paid for.

* "Century Magazine," 1887. † Letter to the London "Times," November, 1884.

REDUCTION IN THE HOURS OF LABOR.—Concurrently with the general increase in recent years in the amount and purchasing power of money-wages throughout the civilized world, the hours of labor have been also generally reduced. In the case of Great Britain, Mr. Giffen is of the opinion that the reduction during the last fifty years in the textile, house-building, and engineering trades has been at least 20 per cent, and that the British workman now gets from 50 to 100 per cent more money for 20 per cent less work.

In the United States, the data afforded by the census returns of 1880 indicate that in 1830, 81·1 per cent of the recipients of regular wages worked in excess of ten hours per day; but for 1880, the number so working was about 26·5 per cent. In 1830, 13·5 per cent worked in excess of thirteen hours; but in 1880 this ratio had been reduced to 2·5. For the entire country the most common number of hours constituting a day's labor in 1880 was ten.*

That the conclusions of Mr. Giffen respecting the general effect in Great Britain of the increase in wages and reduction in the hours of labor, as above stated, find a correspondence in the United States, might, if space permitted, be shown by a great amount and variety of testimony. A single example—drawn from the experience of the lowest class of labor—is, however, especially worthy of record. In 1860, before the war, the average amount of work expected of spade-laborers on the western divisions of the Erie Canal, in the State of New York, was five cubic yards of earth excavation for each man per day; and for this work the average wages were seventy-five cents per day. At the present time the average daily excavation of each man employed on precisely the same kind of work, and on the same canal, is

* The results of an investigation recently instituted by the Prussian Government in consequence of a demand made for an absolute prohibition of Sunday labor in business occupations in that country, have revealed a curious and apparently an unexpected condition of public sentiment on the subject: Thus from returns obtained from thirty out of thirty-five provinces or departments, containing 500,156 manufacturing establishments and 1,582,591 workmen, it was found that 57·75 per cent of the factories kept at work on Sunday. On the other hand, the larger number of the workmen, or 919,564, rested on Sunday. As regards trade and transportation, it was found that in twenty-nine provinces (out of thirty-five), of 147,318 establishments of one sort or another, employing 245,061 persons, 77 per cent were open on Sunday, and 57 per cent of the employés worked on that day. A canvass of the persons naturally most interested in the matter—i. e., the employés—showed, however, that only a comparatively small number were in favor of the proposed measure. Thus, for example, of those who were consulted in the great factories or stores, only 13 per cent of the employers and 18 per cent of the employed were in favor of total prohibition. In the smaller industries the proportion was 18 per cent of the employers and 21 per cent of the employed. In trade only 41 per cent of the employers and 39 per cent of the employed, and in transportation only 12 per cent of the employers and 16 per cent of the employed, were in favor of total prohibition.

reported as three and a half cubic yards, at a compensation of from $1.50 to $2 per day.

Any review of the recent experiences, in respect to wages and hours of labor, would be imperfect that failed to call attention to the fact that the benefits from advances in the one case, and reductions in the other, have accrued mainly to operatives in factories and to artisans and skilled mechanics, and have been enjoyed in the least degree, and largely not at all, by employés, clerks, book-keepers, copyists, etc., engaged in mercantile and commercial operations and establishments. The reason of this is manifestly that the supply of this latter class of labor has been disproportionately greater than that of the former, and continually tends to be in excess of demand; and, under such circumstances, although the amount of discontent may be, and undoubtedly is, very great and well warranted, the organized and aggressive expression of it finds little sympathy on the part of the public.

The question has been asked, Why is it that wages of manual labor have been constantly rising in recent years, while all other prices have been concurrently falling? or, to put it differently, why is it that overproduction, while cheapening the product, should not also cheapen the work that produces it? The answer is, that the price of the products of labor is not governed by the price of labor, or wages, but that wages, or earnings, are results of production, and not conditions precedent. Wages, as a rule, are paid out of product. If production is small, no employer can afford to pay high wages; but if, on the contrary, it is large, and measured in terms of labor is of low cost—which conditions are eminently characteristic of the modern methods of production—the employer is not only enabled to pay high wages, but will, in fact, be obliged to do so, in order to obtain what is really the cheapest (in the sense of the most efficient) labor. The world has not yet come to recognize it, but it is nevertheless an economic axiom, that the invariable concomitant of high wages and the skilled use of machinery is a low cost of production and a large consumption. In the first of the results is to be found the explanation for the continually increasing tendency of wages to advance; in the second, an explanation why the supplanting of labor by machinery has not been generally more disastrous. If, however, it be rejoined that "the *comparative* poverty of cotton- and woolen-mill operatives, and of women who run sewing-machines," and the like, does not sustain the above explanations, the question is pertinent, Comparative with what? For, low and insufficient as may be the wages of all this class of operatives, they were never, in comparison with other times, so high as at present.

IMPAIRMENT OF THE VALUE OF CAPITAL RELATIVELY TO LABOR.—While the remuneration of labor has enormously increased during recent years, the return to capital has not been in any way proportionate, and is apparently growing smaller and smaller. For this economic phenomenon there can be but one general explanation; and that is, that regarding labor and capital as commodities, or better, as instrumentalities employed in the work of production and distribution, capital has become relatively more abundant than labor, and has accumulated faster than it can be profitably invested; and, in accordance with the law of supply and demand, the compensation for its use—interest or profits—has necessarily declined as compared with the compensation paid for labor.*

One efficient cause of this greater abundance of capital is, that every new invention or discovery produces always as much, and often a much greater amount, of product on a less amount of capital than was previously invested. The result of material progress is, therefore, to supplement the need, or economize the use of capital, and at the same time increase it. For example, a first-class iron freighting screw-steamer cost in Great Britain, in 1872–'74, $90 (£18) per ton. In 1887 a better steamer, constructed of steel, fitted with triple compound engines, with largely increased carrying capacity, and consequent earning power, and capable of being worked at much less expense, could have been furnished for $35 (£7) per ton. How rapidly capital has accumulated in recent years under the new conditions of production is indicated by the circumstance that, although most of the great loans which have been negotiated within the last twenty-five

* The position has been taken, by some investigators and writers, that the great decline in the value of capital—by reason of an impairment of the ability of its owners, i. e., through loss of dividends on investments and of profits in business, to purchase and consume the products of labor, and a diversion of capital, from lack of remunerative income-yielding investments, into enterprises not needed and so occasioning overproduction—has been a prime and perhaps the main cause of all the economic disturbances in recent years. That such a factor, in common with many others, has been instrumental in occasioning serious disturbances, may not be questioned; but that its influence has not been in any sense primary would seem evident, when it is considered that the reason why capital has increased and cheapened in these latter years is, that mankind, through a larger knowledge and better use of the forces of Nature, has been enabled to produce, and actually has produced, a far greater abundance of almost all material things (or, in other words, a greater abundance of capital) than at any former period of their history. Capital, at the outset, greatly contributed to such a development, or, like the wizard in the Eastern fable, it pronounced the incantation which set the natural forces at work; but the wonderful increase and consequent impairment in the value of capital was an after-result, something not anticipated, and the continued progress of which the owners of capital, like the enchanter, now find themselves powerless to check. The saving in the cost of the freight moved on the railroads of every country, comparing 1887 with 1850, and assuming like quantities to have been transported at the different periods, would represent every year more than the original cost of the railroads and their equipment.

years have been for the replacement of capital unproductively used up, or absolutely destroyed in war or military operations, and notwithstanding the immense amount of capital that has also been destroyed during the same period by the replacement of machinery contingent on new inventions, the vacuum thus created has not only been promptly filled, but the competition for the privilege of furnishing further supplies of capital for similar purposes was never greater.

Again, as capital increases and competition between its owners for its profitable investment becomes more intense, and as modern methods can bring all the unemployed capital of the world within a few hours of the world's great centers for financial supply, the rate of profit, or interest to be obtained by the investor or lender, from this cause, also necessarily tends to shrink toward a minimum. Such a minimum will be reached "when the returns for the use of capital become insufficient to induce individuals to save it, especially in the form of its representative, money, and thus add to the available reserves by which expanding industries can be supported." And to such a minimum the financial world seems to be always moving by the force of laws which no combination of capitalists can resist.*

* Those not familiar with financial experiences can hardly realize the great decline within the last few years in the price and profits of capital. Thus, the average rates of interest in the cities of Boston, New York, Philadelphia, Cincinnati, St. Louis, and Chicago, as computed from the record of public transactions, from 1844 to 1858, was 10·5 per cent. In 1871 the London "Economist" estimated that the average rate of interest on a majority of the foreign and colonial stocks and bonds at that time held in Great Britain, amounting to not less than twenty-eight hundred and fifty million dollars, was equal to six or seven per cent as a minimum. Up to 1871 the United States had not been able to sell any portion of its funded debt, bearing 6 per cent gold interest in European markets, on terms as favorable as par in gold, United States five-twenty 6s being quoted on the London market in 1870 as low as 87¼. The following is a transcript of the prices of various securities as quoted on the London market in 1871: German Confederation obligations, 5 per cents, 87; French national defense 6s, 87; Massachusetts 5s, 91; Georgia 7s, 78; Spanish 5 per cents, secured by a mortgage on the celebrated quicksilver-mines of New Almaden, in addition to the faith of the Government, 76 and 77; Italian 6 per cents, secured by a pledge of the state revenues from tobacco, 87¼; Japanese 9 per cents, 89; Panama Railroad 7 per cent general mortgage, 93; Michigan Central Railroad, first-mortgage sinking-fund, 8 per cent, 85; Pennsylvania Railroad 6 per cent general mortgage (sterling), 91. To-day the Governments of Great Britain and the United States can readily borrow money at 2½ per cent; all first-class railroad corporations at 4 per cent; while millions of money have been loaned in recent years on real-estate security in the United States for 4 per cent, and in Great Britain for 3 per cent. In Germany the market rate of discount for a considerable period in 1887 was as low as from 1½ to 1¾ per cent. Not many years ago the customary rate of interest allowed by the savings-banks and trust companies of the United States was 6 per cent; now the former for the most part pay but 4, and the trust companies but 2 to 3 per cent. British consuls in November, 1887, paid to the investor 2½⅛ per cent, while of the best (debenture) railroad stocks of Great Britain none now return as much as 4 per cent on their current market prices. The dividends of the Imperial (Reichbank) Bank of Germany in

To those who are the possessors of large properties, a gradually diminishing rate of return for the use of capital makes but little difference so far as personal comforts are concerned; but to the small capitalists the steady reduction in income which has been experienced in recent years means always discomfort, and often misery. A striking illustration of this, derived from actual experience, and contingent on a reduction by the Prussian Government of the interest on its debt to 3½ and 3 per cent, is thus given by a recent correspondent (1887) of the London "Economist":

"This reduction," he says, "struck a heavy blow at the existence of what may be called the 'middle classes' in Germany—that is, the great number of people who own a small capital invested in funds, besides carrying on some business or having some other profession. The combined income from both enabled them to live in fair style, making both ends meet by way of carefully regulated expenditure. These classes have formed for over half a century the 'backbone' of Germany. They are now gradually disappearing, making room for great wealth on one side and great poverty on the other."

DECLINE IN LAND-VALUES.—Another interesting and curious feature of the existing economic condition—the direct outcome of the recent radical changes in the methods of production and distribution—has been the decline in the value of land over large areas of the earth's surface. Thus, in the case of Great Britain, while every other item of national wealth has shown an increase—often most extraordinary—since 1840, the estimated value of land in the United Kingdom since that date has heavily decreased.* A similar experience is also reported as respects France,

the four years from 1883 to 1886 inclusive, declined 0·96 per cent, and the average of the private banks of Germany during the same period, 1·60 per cent; all of which clearly indicates that the banking business of Germany is becoming less and less profitable.

* According to Mr. Mulhall, the English statistician, the following table exhibits the changes in the leading items of wealth in Great Britain since 1840:

[Omitting 6 ciphers.]

	1840.	1860.	1887.
Railways	£21	£348	£831
Houses	770	1,164	2,640
Furniture	385	582	1,320
Lands	1,680	1,840	1,542
Cattle, etc.	380	460	414
Shipping	23	44	130
Merchandise	70	190	321
Bullion	61	105	143
Sundries	710	827	1,869
Total	£4,100	£5,560	£9,210

In 1837 the population of the United Kingdom was 26,000,000; in 1887, it was 37,000,000, an increase during the period of 42 per cent.

Germany,* and Portugal. In the latter country, the owners and cultivators of the soil seem to be in a remarkably unfortunate condition. The Portuguese farmer, despite heavy protective duties, finds himself unable to successfully contend with the increased import of cereals, mainly from the United States. The olive-oil industry, formerly flourishing, is so no longer, through the alleged extensive use of American cotton-seed oil as a substitute; while the demand for Portuguese wines, which for a time was increased by the bad vintages of France, is being impaired, and possibly threatened with destruction, by the continually increasing supply in the French markets of cheaper and more suitable wines for mixing purposes from California, the Cape of Good Hope, and Australia. In addition, the copper-mines of Portugal have suffered severely in recent years from the cheaper supplies of American copper. In the Canary Islands, where the soil is most cheap and fertile, and the vegetation of both the tropic and temperate zones flourishes in great luxuriance, the land question has also become of as much importance and embarrassment as in less favored countries. The former great remunerative industry of these islands was wine, "canary"; but this, by the impairment of the vines, has become of little account. These islands also formerly furnished the world with a large supply of cochineal, for the production of which they have special advantages; but since, through the discovery and use of aniline dyes, cochineal, which was once worth $1.75 (7*s.*), will now command but 12 cents (sixpence), this industry has become depressed. Curiously, also, a comparatively extensive export of potatoes from these islands to the Spanish West Indies is diminishing through a competitive exportation of the same vegetable from the United States. So that there seems to be nothing left for the land proprietors and cultivators in this locality to do, except to resort to the method, so much in favor at the present time, of taxing each other for their mutual benefit! Over large portions of the West India Islands, great quantities of excellent land, advantageously situated as regards facility of communication with other countries, under exceptionally healthy climatic conditions, and much of which has been formerly under high cultivation, has been absolutely abandoned, or is in the rapid

* One of the largest landholders of Austrian Silesia thus recently expressed himself: "A few years ago my estates admitted of the profitable cultivation of wheat; but the price of wheat, through the competitive supplies of the United States, and in spite of high protective duties at home, has declined to such an extent that the cultivation is no longer profitable. The same is true in respect to the domestic (Austrian) growing of cattle. Latterly, the encouragement of the beet-root sugar production, by the granting of bounties by the state on its exportation, has given an opportunity for labor and proved remunerative; but if the state should abandon the bounty system, which is not improbable, my land, as a source of income, seems likely to become valueless."

progress of abandonment. In the United States, the decline in the value of land has, in many instances, been also very notable. In the New England States at the present time, agricultural land, not remote from large centers of population, can often be bought for a smaller price than fifty years ago would have been regarded as a fair appraisal, and even less than the cost of the buildings and walls at present upon it. Since the last decennial appraisal of real estate in Ohio (in 1880) "there has been a heavy decline. Farm property is from 25 to 50 per cent cheaper to-day than it then was."* "In the ten cotton States, the value of agricultural land was in 1860 $1,478,000,000; in 1880, $1,019,000,000, a decrease of $459,000,000. It would require an addition of 45 per cent of its value in 1880 to raise it to its value in 1860." Meanwhile, the population of these same States has increased 53 per cent. "In 1860, the value per acre of improved land in Georgia was $6; in 1886, below $3.50; decrease, $2.50. Were the agricultural land divided out among the people, the value per head would have been: in 1860, $150; in 1886, $63; decrease, $87."†

In the foregoing series of papers an attempt has been made to trace out and exhibit in something like regular order the causes and the extent of the industrial and social changes and accompanying disturbances which have especially characterized the last fifteen or twenty-five years of the world's history. The idea adopted at the outset, and an adherence to which has subsequently been kept constantly in view, has been to relate simply but comprehensively what has happened, and thus prepare the way for a solution of the many problems of interest and importance which are the outcome of the situation, rather than attempt the more difficult and to some extent (at present) impossible task of directly formulating and offering satisfactory answers or explanations. At the same time the presentation of whatever in the way of deduction from the record of experience has seemed legitimate and likely to aid in the determination of correct conclusions has not been disregarded, and with a view of further contributing to such results the following additional considerations are finally submitted:

It seems clear that the first and most essential thing for all those who are desirous of determining the extent of the evils which the recent economic disturbances have occasioned, and what course of procedure on the part of society and individuals is likely to prove most remedial of them, is to endeavor to un-

* "Inaugural Address of Governor Foraker," January, 1887.

† Report of a committee of citizens of the ten cotton-growing States ("Sam" Barnett, of Georgia, chairman), "On the Causes of the Depressed Condition of Agriculture, and the Remedies," 1887.

derstand the situation as an *entirety;* and that effort is likely to be rendered ineffectual and disturbance intensified by all discussions and actions that start from any other basis. In fact, one of the remarkable features of the situation has been the tendency of many of the best of men in all countries to rush, as it were, to the front, and, appalled by some of the revelations which economic investigations everywhere reveal, and with the emotional largely predominating over their perceptive and reasoning faculties, to proclaim that civilization is a failure, or that something ought immediately to be done, and more especially by the state, without any very clear or definite idea of what can be done, or with any well-considered and practical method of doing. The position of the Russian novelist Tolstoi, before noticed, is a case in point. The distressing picture of what the world has come to during the fifty years of the reign of Queen Victoria, as drawn by the poet Tennyson in his new "Locksley Hall," and which Mr. Gladstone has so impressively reviewed and effectually disproved, is another. On the other hand, it may be confidently asserted that a comprehensive view of the situation will show that not an evil referable to recent economic changes or disturbances can be cited, which has not been attended with much in the way of alleviation or compensation, the comparison being between individuals and classes and society as a whole. Thus, the facts in relation to the wages earned by the poor men and women who work for the sellers of cheap clothing, and who seem to be unable to find any more remunerative occupations, are indeed pitiful; but, if clothes were not thus made cheap, many would be clothed far more poorly than they now are, or possibly not at all. It is not the rich man who buys "slop" coats and shirts, but the man who, if he could not be thus supplied, would go ragged or without them. If the decline in the price of cereals and in the value of arable land has forced many who follow agricultural pursuits out of employment, there never was a time in the history of the world when the mass of mankind was fed so abundantly and so cheaply as at present. If the decline in the rates of interest on capital has been a sore grievance to the small capitalists, a reduction in the rate of income from invested property means in the final analysis that the world pays less than it has before for the use of its machinery, and that labor is obtaining a "larger" and capital a "smaller" share of the compensation paid for production.

Inequality in the distribution of wealth seems to many to constitute the greatest of all social evils. But, great as may be the evils that are attendant on such a condition of things, the evils resulting from an equality of wealth would undoubtedly be much greater. Dissatisfaction with one's condition is the

motive power of all human progress,* and there is no such incentive for individual exertion as the apprehension of prospective want. "If everybody was content with his situation, or if everybody believed that no improvement of his condition was possible, the state of the world would be that of torpor," or even worse, for society is so constituted that it can not for any length of time remain stationary, and, if it does not continually advance, it is sure to retrograde.†

It is a matter of regret that those who declaim most loudly against the inequalities in the distribution of wealth, and are ready with schemes for the more "equal division of unequal earnings" as remedies against suffering, are the ones who seem to have the least appreciation of the positive fact, that most of the suffering which the human race endures is the result of causes which are entirely within the province of individual human nature to prevent, and that, therefore, reformation of the individual is something more important than the reformation of society.

To understand the problem of poverty, as it at present exhibits itself, especially with reference to remedial effects, it is necessary to look at it comprehensively from two different standpoints. Viewed from the standpoint of twenty or twenty-five years ago, or before what may be termed the advent of the "ma-

* "The incentives of progress are the desires inherent in human nature—the *desire* to gratify the *wants* of the animal nature, the *wants* of the intellectual nature, and the *wants* of the sympathetic nature—*desires* that, short of infinity, can never be satisfied, as they grow by what they feed on."—HENRY GEORGE.

† The conditions which are naturally imbedded, as it were, in human nature, and which war against the realization of the idea of an ultimate equality in the distribution or possession of capital, have been thus clearly and forcibly pointed out by Mr. George Baden Powell in his "New Homes for the Old Country," published in 1872 after a visit to Australia and New Zealand: "Since the arrival of man in the world there have been perpetual questionings as to why all men are not well off. Why should the good things of this life be so unequally distributed? The two great causes, one as powerful as the other, are *circumstances* and *talents*. But these two opposite causes all through man's life influence each other greatly. Circumstances call forth peculiar talents which might otherwise be uselessly dormant, and talents often take advantage of peculiar circumstances which might otherwise be overlooked and missed. It is by no means improbable that as the world grows wiser some means will be found of considerably raising the lowest stage of existence, but *it is entirely against the nature of things that all should be equal in every way*. Innate pride continually urges men to seek that which is above them, and to many happiness in life is the mere gaining of such successive steps. The essential rule is to work one's own circumstances to the highest point attainable by means of the talents possessed. These talents may be said to resolve themselves into various capitals, and a man may have capital for the improvement of his condition in the form of money, brains, or health and strength—in fact, he may thrive by the possession of 'talents,' whether of gold, of the mind, or of the body. With this fully recognized fact of the diversities of capital, it would seem obviously *impossible for a people to continue long in the humanly imposed possession of equal personal shares in any capital.*"

chinery epoch," there is no evidence that the aggregate of poverty in the world is increasing, but much that proves to the contrary. The marked prolongation of human life, or the decline in the average death-rate in all countries of high civilization; the recognized large increase in such countries in the per capita consumption of all food-products; and the further fact that fluctuations in trade and industry, calamitous as they still are, are less in recent times than they used to be, and less disastrous on the whole in their effects on the masses, are absolutely conclusive on this point. Great as has been the depression of business since 1873, there is no evidence that it has yet made any impression on the "stored wealth" of the people of the great commercial countries; and that, slow as is the accumulation of capital, a year probably now never passes in which some addition is not made to the previous sum of the world's material resources. The recognized tendency of the poor to crowd more and more into the great centers of population—drawn thither, undoubtedly, in no small part by the charities which are there especially to be found, and also by the fact that town labor is better paid than country labor—and the contrasts of social conditions, which exhibit themselves more strikingly at such centers than elsewhere, naturally cause popular observation of poverty to continually center, as it were, at its focus of greatest intensity, and creates impressions and induces conclusions that broader and more systematized inspections often fail to substantiate.* Indeed, one thing which the public needs to recognize more fully than it does is, that in most of the leading nations, systematic and rigid investigations, in respect to most economic subjects and questions, have now been prosecuted for a considerable period by governments and individuals; that the broad general conclusions deducible therefrom in respect to mortality, health, wages, prices, pauperism, population, and the like,

* A chapter from the recent experience of the city of Brooklyn, New York, in respect to pauperism, affords a very striking illustration of this statement. In the five years from 1874 to 1878 inclusive, the number of persons who asked and received outside poor relief from the city authorities increased more than 50 per cent, while the increase in the population of the city during the same period was less than 14 per cent. The evidence would, therefore, almost seem conclusive that the masses of this city were rapidly becoming poorer and poorer. In the latter year, however, the system of giving outside poor relief was wholly discontinued. It was feared by many that this action would lead to great distress and suffering, and many charitable persons made preparations to meet the demands they expected would be made upon them. Nothing of the kind occurred. Not only was the whole number (46,093) drawing aid from the county wholly stopped, but it was also accompanied by a decreased demand on the public institutions and private relief societies of the city, and a reduction in the number of inmates in the almshouse. The teaching of this experience, which has since been elsewhere substantiated, is, therefore, to the effect that what seem to be unmistakable proofs of increasing poverty were merely methods to supplement wages on the gains from mendicancy.

are not open to anything like reasonable doubt or suspicion; and also that the pessimistic views which many entertain as to the future of humanity are often directly due to the exposure of bad social conditions which have been made in course of these investigations with the purpose of amending them.

During the last quarter of a century the problem of poverty has, however, been complicated by a new factor; namely, the displacement of common labor by machinery, which has been greater than ever before in one generation or in one country. To what extent the numbers of the helpless poor have been increased from this cause is not definitely known; but the popular idea is doubtless a greatly exaggerated one. In fact, considering the number and extent of the agencies that have been operative, it is a matter of wonderment that the influences in this direction have not been greater. In the United States little or no evidence has yet been presented that there has been any increase in poverty from this cause.* In London, where the cry of distress is at present especially loud and deep, it is "noteworthy that no measures have yet been taken to ascertain whether that distress is normal or abnormal, and whether it is increasing or decreasing."† But even here the opinion, based on what is claimed to be an exhaustive inquiry, has been expressed that, "although the number of those who are both capable and willing to give fair work for fair pay and are at the same time destitute, is in the aggregate considerable, they yet form but a very small proportion of the unemployed"; and "that probably not over two per cent of the destitute are persons of good character as well as of average ability in their trades."‡ The following additional facts, of a more general nature, are

* According to the Report of the Bureau of Statistics of Labor for Massachusetts for 1887, the whole number of persons of both sexes in that State, who were unemployed at their principal occupation during some part of the year preceding the date of the census enumeration (May 1, 1885), was 241,589, of whom 178,628 were males and 69,961 were females. Comparing these figures with those of the population in 1885, viz., 1,941,465, it is found that for every 8·04 persons there was one person unemployed for some part of the year at his or her principal occupation, the percentage of unemployed being greater in the case of males and less in the case of females. These conclusions, however, throw no light on the number of persons who were unemployed by reasons of displacement by machinery; and are also likely to mislead, unless sufficient consideration is given to the fact that the number of industrial occupations which only admit of being prosecuted during a portion of the year is in every community very considerable. And, as a matter of fact, the investigations in question show that there were only 882 persons representing hardly more than one-third of one per cent of the whole number of the unemployed in this State, who were returned as having been unemployed during the entire twelve months.

† "The Distress in London," "Fortnightly Review," London, January, 1888.

‡ "The Workless, the Thriftless, and the Worthless," "Contemporary Review," London, January, 1888.

also pertinent to this subject: That wages everywhere have not fallen but advanced, as a sequence to the introduction and use of cheaper and better machinery and processes, proves that labor, through various causes—probably by reason mainly of increased consumption—has not yet been supplanted or economized by such changes to a sufficient extent to reduce wages through any competition of the unemployed. The multiplicity and continuance of strikes, and the difficulty experienced in filling the places of strikers with a desirable quality of labor, are also evidence that the supply of skilled labor in almost every department of industry is rather scarce than abundant. Again, it is a matter of general experience that when, in recent years, wages, by reason of a depression of prices, have been reduced in any specialty of production, such reductions have been mainly temporary, and are rarely, if ever, equal to the fall in the prices of the articles produced; which in turn signifies that the loss contingent on such reductions has been mainly borne by capital in the shape of diminished profits. Notwithstanding this, it must be admitted that the immense changes in recent years in the conditions of production and distribution have considerably augmented—especially from the ranks of unskilled labor and from agricultural occupations—the number of those who have a rightful claim on the world's help and sympathy. That this increase is temporary in its nature, and not permanent, and that relief will ultimately come, and mainly through an adjustment of affairs to the new conditions, by a process of industrial evolution, there is much reason to believe. But, pending the interval or necessary period for adjustment, the problem of what to do to prevent a mass of adults, whose previous education has not qualified them for taking advantages of the new opportunities which material progress offers to them, from sinking into wretchedness and perhaps permanent poverty, is a serious one, and one not easy to answer.

A comprehensive review of the relations of machinery to wages, by those who by reason of special investigations are competent to judge, has led to the following conclusions: When machinery is first introduced it is imperfect, and requires a high grade of workmen to successfully operate it; and these for a time earn exceptionally high wages. As time goes on, and the machinery is made more perfect and automatic, the previous skill called for goes up to better work and even better pay. Then those who could not at the outset have operated the machinery at all, are now called in; and at higher wages than they had earned before (although less than was paid to their predecessors), they do the work. Capital in developing and applying machinery may, therefore, be fairly regarded as in the nature of

a force, unintentionally, but of necessity, continually operating to raise all industrial effort to higher and better conditions: and herein we have an explanation of the economic phenomenon that, while the introduction of improved machinery economizes and supplements labor, it rarely or never reduces wages.

One of the most curious features of the existing economic situation is the advocacy of the idea, and the degree of popular favor which has been extended to it, that a reduction of the hours of labor, enforced, if needs be, by statute, is a "natural means for increasing wages and promoting progress."* This movement in favor of a shorter day of work is not, however, of recent origin, inasmuch as it has greatly commended itself to public sentiment in Great Britain and in the United States for many years, and more recently in a lesser degree in the states of continental Europe. But it is desirable to recognize that the early agitation in furtherance of this object, and the success which has attended it, was based on reasons very different from those which underlie the arguments of to-day. Thus, in England and on the Continent, the various factory acts by which the day's labor has been shortened, were secured by appealing to the moral sense of the community to check the overworking of women and children; or, in other words, most of such legislation has thus far been influenced by moral considerations, and has so commended itself by its results that there is probably no difference of opinion in civilized countries as to its desirability. But the form which this movement has of late assumed is entirely different. It is now economic, and not moral, and its final analysis is based on the assumption that the laborer can obtain more of wealth or comfort by working less.

It would seem to need no elaborate argument to demonstrate the absurdity of this position. Production must precede consumption and enjoyment, and the only way in which the ability of everybody to consume and enjoy can be increased, is by increasing, so to speak, the output of the whole human family. If production be increased, the worker will necessarily receive a larger return; if diminished, he will necessarily get a smaller return. And it makes no difference whether the diminution be effected by reduction in the hours of work, or by less effective work, or by disuse of labor-saving machinery, or by other obstructive agencies. The result will inevitably be the same: there will be less to divide among the producers after the constantly diminishing returns of capital have been withdrawn.

It will doubtless be urged that man's knowledge and control of the forces of Nature have increased to such an extent in recent years that almost any given industrial result can now be

* "Wealth and Progress," by George Gunton. D. Appleton & Co., New York.

effected with much less of physical effort than at any former period; and therefore a general and arbitrary reduction of the hours of labor, independent of what has already occurred and is further likely to occur through the quiet influence of natural agencies, is not only justifiable, but every way practicable. This would undoubtedly be true if mankind were content to live as their fathers did. But they are not so content. They want more, and this want is so progressive, that the satisfactions of to-day almost cease to be satisfactions on the morrow. But what "more" of abundance, comfort, and even luxury to the masses has been achieved—and its aggregate has not been small—has not been brought about by any diminution of labor, but has been due mainly to the fact that the labor set free by the utilization of natural forces has been re-employed, as it were, to produce them; or, in other words, recent material progress is more correctly defined by saying, that it consists in the attainment of greater results with a given expenditure of labor, rather than the attainment of former results with a diminished expenditure. Whether the present relation of production to consumption which it now seems necessary should be maintained, if the present status of abundance, wages, and prices is to be continued and further progress made, can be maintained with a diminished amount of labor, may not at present admit of a satisfactory answer. Production in excess of current demand, or overproduction, which has been and still is a feature of certain departments of industry, and which may seem to favor an affirmative answer, is certain to be a temporary factor, for nothing will long continue to be produced unless there is a demand for it at remunerative prices from those possessed of means to purchase and consume, and therefore can not be legitimately taken into account in forming an opinion on this subject; but, other than this, all available evidence indicates that the answer must be still in the negative. Thus, for example, the latest results of investigation by the Massachusetts Bureau of Labor Statistics show that during the year 1885 all the products of manufacture in that State could have been secured by steady work for 307 *working* days of 9·04 hours each, if this steady work could have been distributed equally among all the persons engaged in manufactures. But, to effect such an equitable distribution is at present almost impossible; and if it could be brought about, a reduction of the hours of labor to eight per day in such industries, as has been advocated by many, would reduce the present annual product of Massachusetts to the extent of more than one ninth. Apart, therefore, from the disastrous competition which would be invited from other States and countries where labor was more productive, to expect that under such a reduc-

tion of product the share at present apportioned to the workers, or, what is the same thing, the existing rates of wages could be maintained, seems utterly preposterous. It is not even too much to say that the very existence of multitudes would be endangered if the present energy of production were diminished twenty per cent. And in this connection how full of meaning is the following deduction which Mr. Atkinson finds warranted by investigation, namely: "That over a thousand millions' worth of product must be added every year and prices be maintained where they now are, in order that each person in the United States may have five cents more than he now does, or in order that each person engaged in any kind of gainful occupation may be able to obtain an increase in the rate of wages of fifteen cents a day. Great and undoubted, therefore, as have been the benefits accruing from machinery and labor-saving inventions, the margin that would needs be traversed in order to completely neutralize them by rendering human labor less efficient, is obviously a very narrow one." To which may be added that there is probably no country at the present time where the entire accumulated property would sell for enough to subsist its population in a frugal manner for a longer space than three years.

The greatest of the gains that have accrued to the masses through recent material progress has been in the saving of their time; not so much in the sense of diminishing their hours of labor, as in affording them a greater opportunity for individual self-advancement than has ever before been possible. To clearly comprehend this proposition, it is necessary to keep in view the fact that all men, with the exception of the comparatively few who inherit a competence, are born, as it were, into a condition of natural bondage or servitude. Bondage and servitude to what? To the necessity of earning their living by hard and continuous toil. "In the sweat of thy brow shalt thou eat bread," has been recorded as a divine injunction, and experience shows that a great majority of mankind, as the result of long years of toil, have never hitherto been able to command much more than a bare subsistence. In countries of even the highest civilization, where the accumulation of wealth is greatest and most equably divided, investigation has also led to the conclusion that ninety per cent at least of the population are never possessed of sufficient property at the time of their demise to require the services of an administrator.

Now if, in the course of events, it has become possible, through a greater knowledge and control of the forces of Nature, to gain an average subsistence with much less of physical effort than ever before, what is the prospect thereby held out to the multitude,

who, to secure as much, have heretofore been compelled to toil as long as strength and years would permit? The answer is, the certain prospect of emancipation from such unfavorable conditions. Thus, if eight-hours' labor will now give to an individual the subsistence or living, for the attainment of which ten, twelve, fourteen, or even more hours of labor were formerly (but not remotely) necessary, intelligent self-interest would seem to dictate to him to work eight hours on account of subsistence, and then as many more hours as opportunity or strength will permit; and out of the gain for all such work not required by necessity, purchase his emancipation from toil before age has crippled his energies; or, if he prefers, let him surround himself as he lives, in a continually increasing proportion, with all those additional elements—material and intellectual—that make life better worth living. And, through the rapid withdrawals from the ranks of competitive labor, or the increased demand for the products of labor that would be thus occasioned, the number of the unemployed, by reason of lack of opportunity to labor, would be reduced to a minimum. And that these possibilities are already recognized and accepted by not a few of the great body of workers, is proved by the fact that the greater the opportunity to work by the piece, and the greater the latitude afforded to workmen to control their own time in connection with earnings, the greater the disinclination to diminish the hours of labor.* "No man," says a distinguished American, who from small beginnings has risen to high position, "ever achieved eminence who commenced by reducing his hours of labor to the smallest number per day, and no man ever worked very hard and attained fortune who did not look back on his working days as the happiest of his life." †

* A recent writer, in describing certain factories in New England, where the work is mainly of this character, says: "The days are long for 'piece-work,' and the busy employés are indifferent to eight-hour rules. They reserve only light enough to find their way home, and at twilight they take up their line of march. At present they are earning from three to five dollars per day, according to their capacity." But, as illustrating further how labor treats labor, it is added: "The employés are union men, and they will not allow a single non-unionist to work; neither will they permit any boy under sixteen, or any man over twenty-one years of age, to learn the trade."

† Another, whose life-experience has been similar, also thus aptly states the case: "I have often wondered how workers expect to get on upon eight hours a day. I can not do it. I have worked year after year twelve hours a day, and I know men in my vocation who have done so fourteen hours—not for eight hours' pay, but for fourteen hours' pay. Let a man who is getting day wages for day's work consider how many hours there are in the day. Suppose the day's work is even ten; allow two for meals—that makes twelve; allow nine for sleep and dressing, that makes twenty-one. There are three hours a day for getting on. That is clear profit. There is room for more profit to himself in those three hours than the profit to the employer on the ten hours of his working day. Three hours a day is eighteen in the week—nearly the equivalent of two clear days in the week, a hundred days in the year."

The course of events, nevertheless, warrants mankind in expecting that the progress which has been made in recent years in diminishing the necessity for long hours of labor will be continued; but such progress will be permanent and productive of the highest good only so far as it is determined by natural agencies. "If the attempt is made to save the time of the masses by radical and artificial methods, leisure will become license; but, if they can be taught to save their own time, leisure, as already pointed out, will be opportunity."

Probably the most signal feature of the recent economic transitions has been the extensive decline in the prices of most commodities; and as great material interests have been for a time thereby injuriously affected—commodities at reduced valuation not paying the same amount of debt as before—the drift of popular sentiment seems to be to the effect that such a result has been in the nature of a calamity. Accordingly, a great variety of propositions and devices have been brought forward in recent years, and largely occupied the attention of the public in all civilized countries, which, in reality, have had for their object not merely the arrest of this decline, but even the restoration of prices to something like their former level; and in such a category the attempt to regulate artificially the relative values of the precious metals, the increasing restrictions on the freedom of exchanges, the stimulation of trade by bounties, the formation of "trusts," "syndicates," trade and labor organizations, and the like, may all be properly classed. But all such attempts, as Dr. Barth, of Berlin, has expressed it, "are nothing more than designs to lengthen the cloth by shortening the yard-stick." Decline and instability in prices, if occasioned by temporary and artificial agencies, are to be deprecated; but a decline in prices caused by greater economy and effectiveness in manufacture, and greater skill and economy in distribution, in place of being a calamity is a benefit to all, and a certain proof of an advance in civilization. The mere fact that the general fall of prices which has occurred has been attended with an almost simultaneous and universal increase in the consumption of the necessaries of life and other commodities, is conclusive not only of a great improvement in the condition of the masses, but also that all attempts to retard or reverse this movement by governmental interference or individual organizations, are the worst possible economic policy. In Great Britain alone the decline in the price of meats and cereals between 1872 and 1886 is estimated to have resulted in producing an annual saving to each artisan consumer of $1.95 per head in meat and $3.75 per head in wheat, or an aggregate on 25,000,000 consumers of $142,500,000 per annum. At the same time, and very curiously, investiga-

tions seem to prove that the aggregate consumption of wheat and meats in Great Britain has not in recent years increased; but such an unexpected result will probably find an explanation in the circumstance that the undoubted increased earnings of the masses have been directed to the satisfying a desire for many commodities which formerly they could not gratify, rather than an increased consumption of breadstuffs and meat products.

Judged by their fiscal policies, most governments would also seem to regard a decline in prices, especially in respect to food products, as in the nature of a calamity to their people. With the exception of Great Britain and Holland, nearly every nation —pretending to any degree of civilization—has within recent years greatly increased its taxes on its supply of food from without, and more especially on meats and cereals. A comparison of the prices of wheat in England and France for 1886 shows that French consumers paid during that year alone 6*s.* 3*d.* ($1.50) per quarter more than they would need have done for all the wheat used by them as food in the country, had the free importation of wheat into France been permitted, or $38,000,000 on their minimum aggregate consumption for twelve months. In March, 1887, an increase in the French duties on the importation of wheat further increased its price in France to an average of 9*s.* 8*d.* ($2.19) per quarter over the corresponding average rates in England; which difference, if maintained for the ensuing twelve months, would have increased the aggregate cost of bread to French consumers by the large sum of $87,000,000.

In 1885 the registered sales of horse-flesh for human consumption in Paris were 7,662,412 pounds. In 1886 the sales were officially reported as having increased to 9,001,300 pounds, with an accompanying marked diminution in the consumption of pork. Whether there is any necessary connection between the two experiences need not be affirmed, but the facts are suggestive.

The attempt to crush out of use, by legislation, one of the most brilliant discoveries of the age, namely, the manufacture of butter from the fat of the ox, equally as wholesome as that made from the fat (cream) of the cow, is a libel on civilization; and, as a measure for depriving the masses of a better article of desirable food at cheaper rates, than very many of them have been accustomed to have, or can now procure, would be fiercely resented by them, if once properly and popularly understood.*

* A report on the subject of "Oleomargarine," by the Royal Health Department at Munich, submitted March, 1887, says: "This product is made in great part from such proper ingredients as are useful in nourishment, namely, the fats or greases; and therefore it is of importance, as it furnishes to the poorer classes a subetitute for butter which is cheaper and at the same time nourishing. We think that this want has been supplied

The fact that in no country do the masses ever experience as much benefit from a fall of prices as they would seem to be fairly entitled to, owing to the great difference between wholesale and retail rates, and that this difference is always greatly intensified in the case of the poor who purchase in small quantities, clearly indicates one of the greatest and as yet least occupied fields for economic and social reform. Flour, in the form of bread, costs usually three times more, when distributed to the poorer consumers in cities of the United States, than the total aggregate cost of growing the wheat out of which it is made, milling it into flour, barreling, and transporting it to the bakeries. The retail prices of meats are enhanced in like manner; and investigation some years ago showed that when anthracite coal was being sold and delivered in New York city for $4.50 per ton, it cost the people on the East and North Rivers, who bought it by the bucketful, from $10 to $14 per ton.

Similar results are noticed in all other countries. Out of every £100 paid by the consumers of milk in London, Sir James Caird estimates that not more than £30 finds its way into the hands of the English dairy farmers who in the first instance supply it. In the case of some varieties of fish—mackerel—the cost of inland distribution in England has been reported to be as high as 400 per cent in excess of the price paid to the fishermen. Eggs collected from the farmers in Normandy are sold according to size to Parisian consumers, at an advance in price of from 82 to 200 per cent.

The payment of rent is believed by many to be the chief cause of social distress, and a continual draught on the resources of the poor, for which no adequate equivalent is returned. And yet investigations similar to those (before noticed) which have demonstrated how small need be the first cost of the food essentials of good living, have also led to the opinion that, "not much more than half the money that men usually pay for rent would, if expended in the right direction and under easily prepared guarantees, secure them possession of good homes, protected in all the rights given by a title in fee simple, and which they could transmit unencumbered to their families."

Co-operative associations have done something in the way of remedying the evils resulting from unfair and unnecessary enhancements of prices to consumers buying at retail or in small quantities; but as yet the success that has attended their efforts in this direction, although promising, has been partial and incomplete. Associations of this character appear to find much

in a most satisfactory manner by the manufacture of artificial butter. And it is offered in the markets in a condition superior to natural butter as far as cleanliness and careful preparation are concerned."

more popular favor and support in England than in the United States; and, probably, for the reason that the great establishments which have sprung up in recent years at almost all the considerable centers of population in the United States for the sale of imperishable commodities, and which are systematically conducted on the economic basis that large sales with relatively small profits ultimately assure the largest aggregate of profits, sell goods of the character indicated at lower retail prices than generally prevail in England, and so limit the sphere of beneficial operation of the American co-operative societies.

The relation between prices and poverty has long attracted attention, and nothing new in the way of theory remains to be offered. Three thousand or more years ago, a certain wise man, who had sat at the marts of trade, and made himself conversant with the nature of wholesale and retail transactions, embodied in the following short and simple sentence as much in the way of explanation of these involved phenomena as the best results of modern science will probably ever be able to offer, namely—"*The destruction of the poor is their poverty.*"—*Proverbs, 10th chapter, 15th verse.* Something in the way of a real contribution to our general understanding of this subject would, however, seem to be found in the recent observation that the value-perceiving sense or faculty is not implanted by Nature in every person, but differs widely in different races and families; and that "he who has it will accumulate wealth with comparatively slight exertion, while he who has it not will not gain it, no matter how energetically he labors."* Illustrations of this are familiar to every student and investigator of social science; but the following one seems especially worthy of record: On the ferries between New York and Brooklyn, the rates of toll were some years ago reduced nearly one half to all who would buy at one time (or at wholesale) fifty cents' worth of tickets. But it was soon noticed that the working-classes, who at morning and evening constituted the bulk of the travel, rarely bought tickets, while they were bought as a rule by those who belonged to banking and mercantile establishments.

The countries of the world which within the last third of the century have made the greatest material progress are the United States and Australia. This has been due largely in both cases to the vast abundance of cheap and fertile land, which has occasioned and made possible a great increase in population. Like conditions have been similarly influential in increasing the population of Russia in a more rapid ratio than in most of the other countries of Europe. The United States, by reason of its great natural resources, and extensive use of machinery and con-

* "The Labor-Value Fallacy," by M. L. Scudder, Chicago, 1886.

sequent ability to control the supply and the price of many of the chief staple articles of the world's consumption—cotton, cereals, meats, tobacco, petroleum, and silver—is at present the great disturbing factor in the world's economic condition. But, of all old countries, England leads in all that pertains to civilization; and, making allowance for the exceptional advantages enjoyed by the United States and Australia, her relative progress has probably been as great as that of any country. In no one of the countries of Europe has the increase of population been greater, and in Italy, Germany, and Russia only, has there been an approximate growth; and this result has been especially remarkable, inasmuch as for many years England has not had an acre of virgin soil to expand upon. In no country of Europe, furthermore, has the increase of population been probably so largely accompanied by an increase in comfort as in England. Forty years ago the United Kingdom owned only about one third of the world's shipping. Now it practically owns more than one half, and of the existing steam-tonnage it owns seventy per cent. In respect to exports and imports—comparisons being made per capita—no other nation approximates England in its results to an extent sufficient to fairly justify a claim in its behalf to even the holding of a second place.*

Something of inference respecting the economic changes of the future may be warranted from a study of the past. It may, for example, be safely predicated that whatever of economic disturbance has been due to a change in the relative value of silver to gold, will ultimately, and probably at no very distant period, be terminated by a restoration of the bullion price of the former metal to the rates (60 to 61 pence per ounce) that prevailed for many years prior to the year 1873. The reasons which warrant such an opinion are briefly as follows:

Silver is the only suitable coin medium for countries of comparatively low prices, low wages, and limited exchanges, like India, China, Central and South America, which represent about three fifths of the population of the world, or about a thousand millions of people. Civilization in most of these countries, through the advent of better means of production and exchange, is rapidly advancing—necessitating a continually increasing demand for silver as money, as well as of iron for tools and machinery. Generations also will pass before the people of such countries will begin to economize money by the use to any extent of its representatives—paper and credit, under such circumstances a scarcity, rather than a superabundant supply of silver, in the world's market, is the outlook for the future; inasmuch as a comparatively small per capita increase in the use of

* Robert Giffen, letters to the London "Times," 1884.

silver by such vast numbers would not only rapidly absorb any existing surplus, but possibly augment demand in excess of any current supply.* The true economic policy of a country like the United States, which is a large producer and seller of silver, would therefore seem to be, to seek to facilitate such a result, by removing all obstacles in the way of commerce between itself and silver-using countries, in order that, through increased traffic and consequent prosperity, the demand for silver on the part of the latter might be promoted.

The great reduction in the cost of transportation of commodities has been one of the most striking features of recent economic history. Produce is now carried from Australia to England, a distance of eleven thousand miles, in less time and at less cost than was required a hundred years ago to convey goods from one extremity of the British Islands to the other. The average cost of transporting each ton of freight one mile on the Pennsylvania Railroad during the year 1887 was $\frac{.428}{1000}$ of a cent. At first thought it would seem as if improvement in this sphere of human effort had certainly found a limit; but there are reasons for believing that even greater reductions are possible. Apart from improvements in machinery, and greater economies in operating, very few of the great lines of transportation, especially the railways, have as yet sufficient business to continuously exhaust their carrying capacity; but, when this is effected, and the present large class of fixed expenditures is apportioned to a larger business, lower rates for freight, from this cause alone, will be permissible; all of which, however, is simply equivalent to reaffirming the old trade maxim that it costs proportionally less to do a large than a small business.

An anticipation of an immense increase in the near future, in the commerce between the countries of the western and eastern hemispheres, owing especially to the introduction into the latter of better methods for effecting exchanges and transmitting in-

* According to statements submitted to the Royal (English) Commission on Trade Depression, "The quantity of pure silver used for coinage purposes, during the fourteen years ending 1884, was about eighteen per cent greater than the total production during that period; and there are other estimates which place the consumption at a still higher figure. It is to be remembered that the coinage demand is fed from other sources than the annual output of the mines. It is supplied to some extent by the melting down of old coinage. Allowing for this, however, the evidence of statistics goes to show that the coinage demand for the metal is, and has been, sufficient to absorb the whole of the annual supply that is left free after the consumption in the arts and manufactures has been supplied; and this conclusion is supported by the fact that nowhere throughout the world has there been any accumulation of uncoined stocks of the metal."—*London Economist.*

The situation suggests what is reported to have been contemplated, namely, the formation of a syndicate—like the so-called recent French syndicate in copper—for intercepting the current market supplies of silver by speculative purchases and vast holdings, with a view of compelling an immediate rise in the bullion price of this metal.

formation, is certainly warranted by recent experiences. Thus, if the trade between the United Kingdom alone and the leading countries of the East, exclusive of India, continues to increase in the next quarter of a century in the same ratio as it has during the last quarter, when commercial facilities were much less than at present, its aggregate value of $190,000,000 in 1860, and $440,000,000 in 1885, will swell to $1,038,000,000 in the year 1910; and, beyond that date, to an amount that must be left to the imagination.

That the only possible future for agriculture, prosecuted for the sake of producing the great staples of food, is to be found in large farms, worked with ample capital, especially in the form of machinery, and with labor organized somewhat after the factory system, is coming to be the opinion of many of the best authorities, both in the United States and Europe. And as a further part of such a system, it is claimed that the farm must be devoted to a specialty, or a few specialties, on the ground that it would be almost as fatal to success to admit mixed farming, as it would be to attempt the production of several kinds of manufactures under one roof and establishment.

Machinery is already largely employed in connection with the drying and canning of fruit and vegetables, and in the manufacture of wine. In the sowing, harvesting, transporting, and milling of wheat, the utilization has reached a point where further improvement would seem to be almost impossible. In the business of slaughtering cattle and hogs, and rendering their resulting products available for food and other useful purposes, the various processes, involving large expenditure and great diversity of labor, especially in "curing," succeed each other with startling rapidity, and are, or can be, all carried on under one roof; and on such a scale of magnitude and with such a degree of economy, that it is said that, if the entire profits of the great slaughtering establishments were limited to the gross receipts from the sale of the beef-tongues in the one case and the pigs' feet in the other, the returns on the capital invested and the business transacted would be eminently satisfactory. It is not, however, so well known that the business of fattening cattle by the so called "factory system," on a most extensive scale, has also been successfuly introduced in the Northwestern and trans-Mississippi States and Territories, and that great firms have at present thousands of cattle gathered under one roof, and undergoing the operation of fattening by the most continuous, effective, and economic processes. The results show that one laborer can take care of two hundred steers undergoing the process of grain-feeding for the shambles, in a systematic, thorough manner, with the expenditure of much less time and labor per day than the

ordinary farmer spends in tending fifteen or twenty head of fattening steers under the disadvantages existing upon ordinary farms. In these mammoth establishments "a steam-engine moves the hay from one large barn to another, as needed, by means of an endless belt, and supplies it to a powerful machine, where it is cut into lengths suitable for feeding, and afterward carries the cut hay by other belts to the mixing-room, where by means of another machine it is mixed with corn-meal; the corn having been previously shelled and then ground on the premises by power from the same engine. Again, the mixed feed is carried automatically to the feed-boxes in the stalls. The same engine pumps the water for drinking, which runs in a long, shallow trough within reach of the steers; and even the stalls are cleaned by water discharged through a hose, the supply being raised by the engine and stored for use. The steers are not removed from the stalls in which they are placed from the time the fattening process is begun until they are ready for transportation to the big establishments above mentioned for systematic slaughtering. The advantages of such establishments are not, moreover, confined to labor-saving expedients merely. The uniformity of temperature secured through all kinds of weather is equivalent to a notable saving of feed; for where fluctuations of temperature are extreme and rapid, and not guarded against, "a great deal of the grain which the farmer feeds is 'blown away' after having been consumed by his stock," in form of vital heat, strength, and growth, which are the products of the conversion of the grain on digestion.*

* It has been found that the present usual method adopted on Western farms of feeding grain, especially corn, without previous grinding, is most costly, as the grain in its natural condition is imperfectly digested. Another serious objection to the imperfect methods of the ordinary farm in grain-feeding is, that the grain is fed in a too concentrated form; the fact being unknown, or disregarded, that the thrift of the fattening animal depends largely on the intimate admixture of ground grain with coarse forage; and that hay, also, must be chopped, and more thoroughly intermingled with it, for the attainment of the best results. But the chopping of the hay and straw and the mixing with meal and water is a laborious operation, and hence the economy of applying the steam-engine, and thus saving labor in the business of feeding. Another saving is in building materials; the larger the structure in which the machinery, the hay and grain, and the animals are kept, the less the proportionate quantity of lumber needed; and then, again, in such an establishment, temperature and ventilation, which in ordinary farming are matters that receive little attention, are economically and effectively regulated. An American practical farmer, the owner and manager of seven thousand acres (Mr. H. H——, of Nebraska), to whom the writer is indebted for many items of information, communicates the following additional review of this subject from the American (Western) stand-point: "The average Western farm is now recklessly managed, but capital will come in greater volume and set up processes which will displace these wasteful methods. The revolution is certain, even if the exact steps can not now be precisely indicated. At present the hay, and much of the grain, and nearly all of the tools and implements, are unsheltered; and more than fifty per cent of the hay is ruined for a like reason, while

How great a revolution in the business of agriculture is yet to be effected by the cultivation of land in large tracts, with the full use of machinery and under the factory system, is matter for the future to reveal; but it can not be doubted that the shiftless, wasteful methods of agriculture, now in practice over enormous areas of the earth's surface, are altogether too barbarous to be much longer tolerated; and, as the result of such progress, the return of the prices of meats and cereals to their former higher rates, which many are anticipating on account of the increasing number of the world's consumers, may be delayed indefinitely. Possibly in the not very remote future, the world —as its population shows no signs of abatement in its increase— may be confronted with a full occupation of all farming land and a great comparative diminution of product through an exhaustion of its elements of fertility; but, before that time arrives, improvements may possibly be made in agriculture which will have practically the same effect as an increase in the quantity of land; or possibly chemistry may be able to produce food by the direct combination of its inorganic elements.

Finally, a comprehensive review of the economic changes of the last quarter of a century, and a careful balancing of what seems to have been good and what seems to have been evil in respect to results, would seem to warrant the following conclusions: That the immense material progress that these changes have entailed has been for mankind in general, movement upward, and not downward; for the better and not for the worse; and that the epoch of time under consideration will hereafter rank in history as one that has had no parallel, but which corresponds in importance with the periods that successively followed the Crusades, the invention of gunpowder, the emancipation of thought through the Reformation, and the invention of the steam-engine; when the whole plane of civilization and

the animals themselves (I do not mean now on the wild-stock ranges, but even on the trans-Missouri farms) have no roof over their heads, except the canopy of heaven, with the mercury going occasionally twenty and even thirty degrees below zero. These wasteful methods in farming are in part promoted by the United States homestead law, and the occupation of the hitherto inexhaustible expanse of cheap lands. When the ignorant, degraded, and impecunious can no longer acquire a hundred and sixty acres upon which to employ their barbarous methods, and when the land already taken up shall have risen from the low prices at which it now stands to fifty dollars or more per acre, a new dispensation will arrive. Neither the cattle, nor the food which the cattle consume, will then be raised by any such methods as now prevail; neither will they be exposed to the elements in winter. True enough, the opening up of other virgin fields in Australia, South America, Africa, and elsewhere, may retard this rise in the value of the land in the western part of our continent, and thus to a certain extent delay the passing of the land exclusively into the hands of larger capitalists and better managers; but it must be considered that not all climates are suitable for energetic, capable farming populations, and likewise that the best forage plants are restricted to temperate latitudes."

humanity rose to a higher level; each great movement being accompanied by social disturbances of great magnitude and serious import, but which experience proved were but temporary in their nature and infinitesimal in their influence for evil in comparison with the good that followed. And what the watchman standing on this higher eminence can now see is, that the time has come when the population of the world commands the means of a comfortable subsistence in a greater degree and with less of effort than ever before; and what he may reasonably expect to see at no very remote period is, the dawn of a day when human poverty will mean more distinctly than ever physical disability, mental incapacity, or unpardonable viciousness or laziness.

THE MORAL INFLUENCE OF CLIMATE.

By FELIX L. OSWALD, M. D.

A PHILOSOPHIC advocate of religious tolerance holds that "the most effective way to explode a popular fallacy is to explain it." If we should apply that method to the exorcism of the mediæval specters that still haunt the by-ways of the nineteenth century, we might say that the moral aberrations of the middle ages sprang chiefly from the *tendency to underrate the moral effects of physical causes.* If the chronic despondency of a mediæval dyspeptic reached the phase of suicidal temptations, his confessor would advise him to defeat the wiles of the arch-fiend by devoting his leisure to the recitation of a few thousand paternosters. If peppered hash and want of exercise had vitiated the temper of his wife to an unbearable degree, he was instructed to consider the visitation a judgment incurred by his unbelief, or by his opposition to an extra assessment of the tithe-collector. The epidemic increase of the alcohol-habit was persistently treated as a disorder amenable to the influence of prayer-meetings. For nearly a thousand years the history of European morals was, indeed, the history of the efforts and failures of visionaries who hoped to reconcile the promotion of ethical reform with a total neglect of physiological studies.

Since the revival of naturalism, however, the tendencies of educational reform make it probable that the progress of moral philosophy will become identified with the development of a new science, thus far only outlined in a few incidental treatises on the *interaction of body and mind.* The possibilities of that science are suggestively indicated by the results of the statistical studies devoted to one of its branches—the moral influence

of climate. Modern French scientists are nothing if not methodical, and have repeatedly called attention to the curious regularity in the geographical distribution of certain vices and virtues: intemperance, for instance, north of the forty-eighth parallel; sexual aberrations south of the forty-fifth; financial extravagance in large seaport towns; thrift in pastoral highland regions. It is, indeed, a remarkable circumstance that in the home of the best wine-grapes, in Greece and southern Spain, drunkenness is far less prevalent than in Scotland, or in Russian Poland, where Bacchus can tempt his votaries only with nauseous *vodka*. The idea that a low temperature begets an instinctive craving for alcoholic tonics seems disproved by the teetotalism of the Patagonian savages, who horsewhip every Spanish stimulant-monger without benefit of clergy. The Lesghian mountaineers, too, observe the interdict of the Koran in the icy summit-regions of the Caucasus; but there is no doubt that the bracing influence of a cold climate affords a certain degree of immunity from the debilitating effect of the alcohol-vice, and that a Scandinavian peasant can for years survive the effects of a daily dose of alcohol that would kill an Egyptian fellah in a single month. But it is equally certain that the temperance of south-land nations is considerably facilitated by the abundance of non-alcoholic pastimes. The Spaniards have their fandangos and bull-fights; the Greeks their border-raids, cocking-mains, and horse-races; while the Scotchman, after six days of hard work, is confronted with the choice between the delirium of an alcohol-fever and the appalling tedium of sabbatarian asceticism, and naturally chooses the less dismal alternative.

The question, though, remains, if religious gloom itself is not an outcome of climatic influences. Cardinal de Retz, indeed, held that orthodox loyalty is a flower that can not flourish north of the Alps; but it is more than probable that the survival of that plant has been greatly assisted by the conniving *bonhomie* of south European ecclesiastics, who, centuries ago, began to appreciate the wisdom of extending the practice of renunciation to the claim of consistency. The "climate of superstition" can not be defined by geographical specifications; but, as the gilded clouds of the South float grizzly over the moping firmament of the North, dogmas which the inhabitants of the lower latitudes manage to reconcile with a good deal of secular beatitude are apt to assume a gloomy character in the land of the hyperboreans, whose rational rigorism, however, may recalcitrate against self-contradictory tenets, and accept a thoroughly uncomfortable more readily than an illogical doctrine. Thus we find the Nahagathas, the Protestants of Buddhism, confined to Japan and northern China, and the schismatic Shiites to the

Islamized highlands of Central Asia. The most obstinate dissenters of the Greek Church have their strongholds in northern Russia, while the heresies of the Cossacks are limited to ultra-convivial celebrations of ecclesiastic holy-days. Even in ancient Greece the South-Hellenic Spartans seem to have been much less heterodox than their North-Hellenic rivals.

The supposed concomitance of low latitudes and low morals—in Origen's sense of the word—is a theory considerably modified by the reports of our latter-day north-pole explorers. Chamisso, Pallas, Adams, Gabriel Sarytchew, and Kane agree that certain tribes of the polar regions are sensual to a degree that would have scandalized the natives of ancient Lesbia, and certainly suffices to amaze the modern Cossacks, who, in their turn, astonish the not over-scrupulous moralists of the Danubian principalities. Among the Yakoots of northern Siberia *mésalliances* of an unmentionable kind are condoned as readily as a still more unprecedented degree of sexual precocity which Chamisso ascribes to the "almost exclusively animal diet of the wretched pygmies." Our equally carnivorous Indians are, however, characterized by a sexual apathy which an able American ethnologist seems inclined to consider a principal cause of their gradual extinction; and Chamisso's hypothesis must probably be supplemented by other explanations—for instance, the enforced idleness of his pygmies during the snow-bound season of short days and overlong nights. Idleness may likewise account for the erotic excesses of islanders enjoying the benefits of a fertile soil and a genial climate, like the notorious natives of various parts of the Grecian Archipelago and the Lesser Antilles, not to mention the *ne plus ultras* described in the reports of the first South Sea explorers. As a rule, the prevalence of incontinence bears an inverse ratio to the predominance of *active* modes of life; in any sense of the word, the continence of hunters and nomads being almost rivaled by that of intensely industrial communities.

Cæteris paribus, however, precocity increases with the distance from the isotherm of Stockholm, about the sixtieth degree of northern latitude in Europe and the forty-fifth degree in the western hemisphere. North of that parallel the stunted and short-lived hyperboreans marry as early as the premature children of the tropics, tropical highland regions generally excepted. The copper-colored natives of the Peruvian *alturas* marry late, while under the same parallel the creoles of the Brazilian lowlands do not hesitate to encourage the matrimonial propensities of children in their earliest teens, boys of fourteen and girls of thirteen and twelve, or, if we shall believe Dr. Burmeister, even of ten and nine. The courtships of Sicily, too, are expeditious,

even from an Italian point of view, while on the island of Corsica a peculiar state of agrarian difficulties has counteracted the influence of climate. Many of the *campanitas* or small terrace-plains have been so utterly exhausted that the available means of irrigation fail to redeem the impoverished soil, while a large percentage of the productive area is in the hands of the convents, which reserve the right of tenure for their old retainers. Combined with the straits of that land-famine, the over-increase of population became such an unqualified evil that the common sense of the peasants originated a system of ostracism, attaching infamy and social excommunication to the preliminaries as well as to the results of marriage before a specified age. In France the enormous burden of taxation has practically led to an identical result, and the prevalence of a mode of existence which Edmond About calls the "celibacy of prudence" is no longer confined to the larger cities.

The late marriage of mountaineers, too, may be partly explained by their instinctive love of independence. The sterile soil of a highland region necessitates far and frequent excursions in quest of the means of subsistence, and the unencumbered privilege of personal freedom thus became often a condition of survival. With a marmot and a hand-organ, if not with a marmot alone, the young Savoyard perambulates Europe from end to end till he has accumulated the equivalent of an Alpine competency. The *monteros* of the upper Apennines roam Italy like gypsies, ready to do any man's harvest-work. Young Scotchmen cross the Tweed or even the Atlantic before they venture to run the risks of matrimony on the precarious resources of a Highland moor. The scantness of population, and the consequent distance from neighbor to neighbor, help to train highlanders in the habits of self-help, and thus form that instinct of independence which has generally justified the proud motto of West Virginia.

A similar cause, however, would seem to have produced a similar result among all true nomads, who likewise are obliged to

"Make each day earn the daily right to live."

But while the patriotism of the Arabs and Turkomans (as well as of the originally nomadic Hebrews) takes the form of an exportable national pride, a sort of hygienic intuition appears to teach mountaineers the superiority of their native climate and make them averse to a permanent change of habitation. Highlanders, though the stoutest defenders of their native soil, have therefore rarely engaged in wars of conquest; and the most *expansive* nations, to use a Bismarckian euphuism, were generally lowlanders—Prussians, Russians, Arabs, Mongols, Goths, and Tartars. We might add Romans, for the tide of conquest which

inundated all the coast-lands of the Mediterranean originally emanated from the plains of Latium; and, if Mr. Katkoff's prognosis should be fulfilled by the disintegration of the American Union, it would be safe to predict that the larger part of our present territory would be reconsolidated by some eupeptic lowland State, Missouri or Michigan, and that the Alleghanies would maintain their independence by the stubborn resistance of their highlanders. The nomadic herders of western Texas, too, might prolong that resistance for many years; but, on the whole, the march of the new empire would follow the course of the Mississippi, for the double reason that the stream of conquest has generally moved seaward and southward. Russia will not rest till her fleet rides the eastern Mediterranean as well as the Euxine. Tamerlane avowedly intended to extend his empire to the Atlantic; and, from the campaigns of King Cyrus to the expansive enterprises of Victor Emanuel, nine out of ten international wars have ended with the victory of northern nations over their southern neighbors. The goddess of fortune would decline to be crowned with a fur cap, and the sun of the south that turns a lynx into a lion does not necessarily reverse the process in the case of the human animal; but it is true that a rigorous climate evolves superior "staying power," and in war the last shout is worth a dozen challenges. The history of Europe might, indeed, encourage the idea that certain northern nations love war for its own sake, though Prof. Vogt informs us that gratuitous combativeness is a sign of specific inferiority. "Ants and wasps that tackle every wayfarer," says he, "can not compete with the species that reserve their energy for serious emergencies, and without the protection of the dog-fancier the breed of bull-dogs would speedily succumb to their preposterous propensities." Waspish aggressiveness would rather seem to be a product of sterile plains, that appear to bristle with stilettos as spontaneously as with cactus-thorns—the brigandage of Turkistan and stony Araby having its exact analogue in the kidnapping and train-robbing rowdyism of our arid Southwest.

Nor is it quite certain that the "instinct of industry" can be considered an exclusive product of the higher latitudes. When all northern Europe was still slouching in bear-skins, Egypt and Phœnicia were buzzing hives of industrial activity. Our North American Indians had only wigwams when Mexico was studded with palaces. But here, too, the virtue of perseverance seems to have prevailed against the talent of initiation, and the energy of the North, once started in the arena of industrial competition, has managed to distance the earlier enterprise of the South.

Civilization, in the modern sense of the word, is, however, to a large extent founded on the activity of the instincts of co-op-

eration and altruism, both of which are undoubtedly stimulated by the emergencies of a rigorous climate. A hard-headed northlander who has himself been snow-bound and frost-bitten will not ignore the distress of a help-needing neighbor; while the religious charity of the Siamese peasant is apt to be modified by the reflection that, after the total loss of their fruit-crop, his storm-stricken brethren in Buddha can still eke out a tolerable living in the woods.

IS COMBINATION CRIME?

By APPLETON MORGAN.

WHEN, a few months ago, announcement was made, in despotic opulence of mural decoration, that Mr. Barnum's and Mr. Forepaugh's circuses had pooled their attractions under a single tent, the American small boy lodged no protest, nor did he invoke the statutes of this republic against the dangers with which its institutions were threatened. But when whisky, or coal, or cotton-seed oil, or prunes, or beeswax, propose to adhere in happy family compact, the occasion is not allowed to pass without jeremiad on the perils of this commonwealth and the departure of the liberties of this people.

In a paper entitled "Modern Feudalism," in the "North American Review" for April, 1887, I understand Mr. James F. Hudson to suggest that any old-fashioned ideas as to the economy of large producers over small ones, and supposed consequential security of wages, greatest good of the greatest number, etc., which may still obtain in the community, are survivals of the dark ages, and without place in the enlightened civilization of this continent; and to assert that any combination of corporations or large manufacturers or producers for manufacture or production of a single staple, which shall purchase the interest or business of smaller manufacturers or producers, is a menacing danger, not only to the consumer, but to the State. Mr. Hudson has nothing to submit as to any possible small competitor who might perhaps be willing or even anxious to be crushed out "for a consideration" rather than assume all the chances of himself crushing out the larger competitor. Nor do I find him discussing the question as to what interest it is to the consumer whether the product he consumes be manufactured or quarried by a small concern or a large one. His propositions, however, are sufficiently startling to the old-fashioned reader of what once was the science of political economy to warrant, I think, a passing notice in the pages of "The Popular Science Monthly."

Mr. Hudson, to begin with, is of opinion that any incorpora-

tion, combination, or "trust" organized for business purposes is a "corner" in the thing manufactured, and therefore against the written law of the land as well as the public interest. He is wrong here at the outset. Everybody who knows anything about the matter knows that to "corner" a product is to raise its price, not to the consumer, but to the operators against whom the "corner" is engineered. However disastrous a "corner" may be to the "shorts" who fight it: ultimately fatal to the schemers (who risk public indignation if they succeed or the prospect of bankruptcy if they fail in sustaining it), I have yet to learn of any permanent injury to the consumer—or to the great body of the people—resulting from the wickedest corner that ever was attempted. Without attempting any palliation of or excuse for the gamblers who stack staples instead of "chips" and shuffle values instead of cards, it is yet, perhaps, proper to suggest that even trusts, combinations, and incorporations for business purposes are of some ultimate good to the community and benefit to the bread-winner; and to point out the actual fact that, so far from raising, it is to the immediate interest of a combination of small business interests into a large one to at once cheapen the prices of its product to the very minimum margin of profit at which manufacture can be carried on. Otherwise, the crop of new combinations to be bought out would be endless. For, surely, so long as the product in which the combination deals can be manufactured at a profit, just so long will there be manufacturers. Mr. Hudson, no doubt, burns gas. But any consumer of illuminating oil can tell him that he can buy from an agent of Mr. Hudson's pet grievance, the Standard Oil Company, cheaper* than he could before there was any such terrible "octopus," and when every producer had his favorite jobber; and if Mr. Hudson ever sent a telegram from New York to Chicago before the days of the Western Union Telegraph Company (which, naughty as it is, only charges twenty-five cents for ten words to Chicago), at the rate of about two dollars per ten words to Chicago, without grumbling at the positive incongruity of the price, he is a much more reasonable man than some of his readers take him to be. And to demonstrate that—whatever the immediate causes—the immediate effect of combinations is apt to be to convenience rather than to incommode the customer or client; let me allude, in passing, to (what everybody knows) the fact that the single

* The Standard Oil Company has so reduced the cost of the process of refining that the price of refined oil has been lowered from seventy to less than seven cents per gallon. The people who paid four dollars per capita for light now pay less than forty cents per capita, which is equivalent to a benefit to the people of this country (counting them at 60,000,000) of $216,000,000 per annum.—"New York Tribune," May 15, 1887.

powerful ownership of the telegraph lines of the United States has resulted in the steady improvement of the service (the sending of four messages at once upon a single wire and in opposite directions being not the greatest of these improvements). Perhaps Mr. Hudson thinks that these improvements would have been more patriotically used if the inventors had employed them to break down, instead of to aggrandize and strengthen, the "monopoly." But unless Mr. Hudson dreams of a paradise where inventors seek not to be paid, are not stimulated to activity by hope of reward (if, that is, he writes for his contemporaries and not for an ideal republic), he must be aware of the impossibility of legislating away the inducements to human industry or the instinct of men to prefer worldly prosperity and bank accounts to poverty and dependence. Had these inventions been used to break down existing companies, the result would have been finally the same. They would have been purchased by the strongest purse. But the inventor would first have been ruined. But Mr. Hudson, for one, still writes. Such propositions as that there is not a dollar of capital in the United States which does not represent somebody's labor and somebody's self-denial, or that every dollar which accrues in profit to-day to the railroads or other great corporate interests of this country represents from two hundred to three hundred dollars paid directly, and in cash, to the wage-workers (the very men for whom Mr. Hudson assumes to speak)—such propositions, I say, do not deter him in the least, nor do I anticipate that they ever will. If the corporations of the United States (chartered by the people of the United States for transportation, manufacturing, and other purposes), in endeavoring to keep abreast of the commerce and trade of the people of the United States, have grown to such enormous proportions as to attract the envy and enmity of those not holding their securities, I respectfully submit that that is no reason why those corporations should be punished, or their interests wrecked, embarrassed, or confiscated, Mr. Hudson to the contrary notwithstanding.

The fact—the truth is, that (however it may be in other countries) the accumulation of wealth and centralization of commerce in great combinations has never, in the United States, been a source of oppression or of poverty to the non-capitalist or wage-worker. The greatest oppressors of the poor, to the contrary, are not always the largest corporations. It is quite as likely, for example, to be a small Chatham Street haberdasher (who himself struggles against the bottom prices of his next-door "puller-in"), as a Broadway furnishing company, who pays a starved seamstress three cents apiece for making shirts, and holds a chattel mortgage on her sewing-machine as security

for the material upon which she operates it. Mr. Hudson appears to infer that the smaller the manufacturer, the better off the consumer and the wage-worker; that the smaller he is, the smaller his prices to the one and the higher his wages to the other. I do not claim that the larger the shirt-dealer, the higher the prices he pays to his seamstresses. I do not claim that the soulless individual becomes soulful the moment he finds himself incorporated (the epigram is the other way). But I do claim that the converse is not the fact. I have not had Mr. Hudson's opportunities, perhaps; but, so far as the laws of human selfishness and greed go, I happen to know that the larger the principal the more secure the wages of the wage-worker, and the scale thereof at least not necessarily or even probably lower.

The fact is (whether Mr. Hudson will ever become aware of it is another and less important consideration), that the very first thing a successful manufacturing combination does, and must do, is to put the price of its product down to a figure where it will not pay for designing speculators to form new stock companies for it to "crush" at a hundred or more cents on a dollar. For, did it keep up its prices, either one of two things would inevitably happen: either new factories would be started, or the inventive genius of this people would invent a substitute for the product they furnished, and so ruin the combination beyond resurrection.

So rapidly have prices lowered, indeed, in the past, and so constantly are they still falling, that earnest economists have begun to wonder what the end would be; and even the labor agitators have turned from the (to them) seemingly abstract question of hours and wages, as between the employer and the employed, to find in this the supposed greatest peril of the latter. It even appears that one Powderly, a chief of one of the so-called "labor movements," has made it the text of certain of his harangues. And, with what Dickens would call perhaps "a fatal freshness," Mr. Hudson himself (who has just left denying the right of industries to centralize themselves because the first thing they did after centralization was to put up prices), on the next page, says, "Mr. Powderly has inveighed against the sin of cheapness, and given his assent to the principle of combination to raise prices, on the assumption that such combinations involve an advance in wages." (Though to what purpose Mr. Hudson has preserved this excerpt his context fails to discover, since good faith to his own argument, if not to his readers, should have led to its suppression.)

But Mr. Hudson rattles on as follows: "It is an old truth that commerce, founded on the basis of distributing the staples of life at the least cost, is the highest practical benevolence;

while devices to rule commerce by the suspension of competition, and to exact arbitrary profits from the masses, are the extreme of selfishness and oppression. The universal nature of this truth was perceived when the world emerged from the mediæval system of economics, but it seems in danger of being forgotten. This is illustrated by the criticism of Mr. E. P. Alexander, the most recent writer on the railway question, that those who hold competition to be the only just measure of profits in any industry are years behind the age in comprehension of the science of the railway question."

Whatever there may be beyond platitude in the above is pure invention. The element of "the least cost" as parcel of the definition of "commerce" is certainly novel, and as interesting as it is novel. And certainly, too, the remainder of the sentence—from the words "the universal nature of this truth" (which truth?—Mr. Hudson has alluded to several) onward—is an extremely remarkable statement to come from the pen of a writer who assumes to deal with economical questions and matters of social science. The allusion to Mr. Alexander is equally childish, and without bearing upon the matter which we believe Mr. Hudson claims to be discussing; unless, indeed, he thought it necessary to show, in passing, how thoroughly he had failed to comprehend the question of American railway systems, to the discussion of which Mr. Alexander has lately contributed a most admirable monograph. When Mr. Alexander used the words dragged from their context as above, he was pointing out how the question of modern industrial competition had long since ceased to involve simple problems of competition in getting business alone; how it at present includes also the element of the cost *versus* the price of doing business at all—that is to say, the value of the opportunity to do business at all, as against the actual outlay in cost necessary to do the business brought to the party offering to do the business at all (which element, everybody—who knows anything of the matter at all—knows to be not only a very serious and a very practical one, but actually the paramount one, under present conditions). (As others besides Mr. Hudson may be ignorant of Mr. Alexander's meaning just here, I may explain that, to the railway, the value of doing a competing business, of keeping its trains running and so perpetuating its charter, is naturally always a larger consideration than the mere question of a profit—is, in fact, the most vital consideration that could be named. Or, should the question present itself differently: a bankrupt railroad is worse than no railroad at all. It can run recklessly and cheaply, since unable to respond in damages for lives or property injured or destroyed. And yet, were competition the only rule by which

railways were operated among themselves, this very bankrupt road could force every neighboring road to regulate itself by its own tortuous procedure. For, just as a chain is no stronger than its weakest link, so the best railroad in the country can be no better than the worst, if competition and nothing but competition is to be the rule.)

But with all earthly matters Mr. Hudson will have nothing but competition. He will not hear of such a thing as a combination. He proceeds: "But the very question at issue is whether they (i. e., these old ideas of competition) are not more in accord with the essential principles of nineteenth-century democracy than those who are turning commerce back to the era of prices fixed by combinations and the suspension of competition." If this is the very question at issue, it would seem as if Mr. Hudson has so far been artfully misleading us. He certainly has not alluded to it before. So far as careful perusal of his paper has informed us, the question at issue seemed to be whether a small manufacturer had a right to sell out his business to a bigger one; at what point a large manufacturer, who has used his capital in buying out his smaller neighbors, must call a halt, and submit to a redistribution all around; and as to whether small manufacturers should be compelled to do business at a loss rather than sell out to larger ones. However, let us patiently shift our ground as often as necessary, if so be we can discover what it is that our Mr. Hudson really does mean. If it is a fact that modern civilization has really introduced new elements—and other principles besides the principle of competition—into commerce, then by all means let us abolish, let us destroy them (Mr. Hudson knows how to destroy a principle), and get back at once—to what? Not to feudal days, certainly; for that would be modern feudalism, and that is what Mr. Hudson will none of. Perhaps we had better, while we are about it, go back to the Deluge, to Noah the navigator, who spent one hundred and twenty years in building a ship whose quarter-deck he was himself to tread—although it does not appear that Noah had any competitors in the ark-building trade—to the patriarchal rather than to the feudal system.

But, having decided where to go, how are we to turn back commerce? What is commerce? Webster says that what we mean by that term is "the interchange or mutual change of goods, wares, productions, or property of any kind between nations, by purchase and sale, trade, traffic." Very powerful indeed, one would imagine, must be the forces or agencies which shall turn back such tendencies as these—the operations of the laws of human necessity which culminate in the rule of supply and demand as working upon the entire human race. Accord-

ing to Mr. Hudson, however, these tendencies, laws, and rules do not amount to so very much. It is an easy enough matter to handle them. We have only to legislate railway companies out of existence, and then enact statutes forbidding two of the same trade to combine. Then things will run smoothly. The State will hold the trackage of the late railroad companies as a highway; and every dealer, manufacturer, agriculturist, miner, will carry his product to and fro, and—there you are! No more modern feudalism; nothing but peace, plenty, and communism!

Faulconridge would not fright boys with bugs, but a moral drawn from the middle ages, by reason of its mere remoteness, appears always to be a powerful antic with which to worry the non-capitalist imagination. Any combination of like interests for business purposes—the copartnership formed by three butter-dealers or six coal-miners to continue the business of selling butter or mining coal; the corporation, or "trust," or combination formed by amalgamation of any existing companies—is a palpable return to the days of feudalism. Thus, the present system of combinations becomes "modern feudalism." Your combinations are so large that they build up a favored and aristocratic class, like the old crown vassals. And again, these industrial combinations are hand and glove with the railways, and so form a network of capital in the meshes of which the poor man is strangled. Now, the simple facts upon which Mr. Hudson assumes to found this hue and cry are these, viz.: The normal tendency of trade to trade-centers, where it can be most conveniently handled, has its inevitable corollary in the tendency, within the trade-center, to centralization of the different branches of trade. In the middle ages the principle operated to build up such imperial centers as Nuremberg, Antwerp, and London, and the corollary to organize, within those centers, the great trade-guilds. In later years the Atlantic Ocean, the Hudson River, and Long Island Sound combined to make New York city an emporium for the deposit and distribution of the products and industries of two continents, while the merely innocent convenience of traders within that city (not any aristocratic or would-be feudal motives on their part) operated to root and group the leather interest into one quarter, cotton goods into another, oils and provisions and iron-mongery into still others. And if two or more traders in an identical staple, finding themselves neighbors or united in a community of interest, saw fit to bind themselves into a single firm or trading company, it was no matter of conspiracy against the public weal, but the merest consideration of personal convenience and facility. When the railroads came, they found themselves obliged—by the very charters which created them—to haul for anybody who chose to em-

ploy them, and to do the most extensive hauling for those who had the largest bulk of hauling for them to do. They were not authorized by their acts of incorporation to first demand certificates of good moral character, or affidavits that the would-be customer was not a combination of individuals or stockholders in a trust or a private corporation. And yet, superfluous as this statement is, it is actually out of such familiar truisms as these (it is difficult to treat the simpleness of the situation without tautology) that Mr. Hudson raises figment after figment and chimera after chimera to disturb and alarm the non-producing and manufacturing classes of this already imperiled community! And the purport of these figments and the portent of these chimeras is always that any use of capital in bulk is crime against this people and this republic; and that the incorporation for business purposes "stands in" with some railway company or all railway companies, because incorporations—and especially railway incorporations—hate the bread-winner and the wage-worker, and desire that he be crushed and swept from the face of the earth; in other words, are feudal, mediæval, and unpatriotic. That is the whole text and comment of Mr. Hudson's elocution. Even feudalism itself was not a curse. It was a proper and convenient institution for its day and date; considering the popular ignorance and helplessness, anything else would have been a less tolerable tyranny. It was the growth of circumstances, rather than—as Mr. Hudson thinks—the forcing of an arbitrary situation by the strong and aristocratic upon the plebeian and the weak: so, to begin with, granting Mr. Hudson's favored and capitalist class, and granting that they "force" any condition of things upon the non-capitalist class, the analogy of this state of things to the institution of feudalism is false and misleading. But feudalism was more than a situation. It was the only form in which the society of the unlettered and formative civilization could be held together at all—the only one which could, on the one hand, curb the despotism of thrones, while on the other conserving the safety and tranquillity of the people. It was the mother of parliamentary government and of civil liberty, to which—in the fullness of time—it yielded and disappeared.

To give a meaning to Mr. Hudson's vision of an analogy between modern industrial centralization and feudalism, let us assume, however, that he means (he does not say so) the mediæval trade-guilds. Now, these trade-guilds, perhaps, were an accompaniment of—certainly they were contemporary with—the institution of feudalism. Moreover, they were broken up and wiped away by the very institution which Mr. Hudson can not find words enough to stigmatize as the root of every modern

evil—viz., the growth of private capital and the combinations of capitalists. The mediæval guild was a thing apart, and its type and character have disappeared forever; and yet, peaceful and judicious as those guilds were, even the anarchist and labor unionist of to-day may dignify his district delegation by comparing it to the guilds of the middle ages, with more show of reason than can Mr. Hudson compare them to our modern corporations. The modern trades-union is an organization whose object is to monopolize—or at least to secure—the right to labor for wages for its own members; to prevent by force, if necessary and convenient (and it latterly has been supposed to be both necessary and convenient), the labor of anybody not one of its members; and to boycott any employer who claims the right to employ the labor of anybody and everybody not its members. The ancient guild was composed of the masters of a certain trade; of men who had, by mastering its practical art, become entitled to that designation—men who practiced it for a livelihood. It had also the industrial and educational function of perpetuating itself by the training of its apprentices to become, in their turn, masters. In the days of feudalism, when the great crown tenants held their territory from the crown by fee of service in its wars (a service they levied on the people to perform in time of war, grinding a profit to themselves by way of reprisal from this same people in time of peace), these guilds preserved the useful arts which ameliorate our own happier times. Each guild met and discussed the state of its particular trade; devised means of improving it (their discussions taking the place now filled by the industrial newspaper, the trade-journal, and the price-current). It passed laws also; but these laws were for the guidance of its own members, not by any means to be supplied outside of it in an attempt by force of arms to make employment for its own members at the expense of the vested rights and liberties of the rest of mankind. So honorable were they in thought, deed, and word, that the wealthiest London merchant to-day is not above marching in procession in their memory behind their banners on Lord-Mayor's-day, arrayed, as Chaucer says they were in his:

> "... in one livery
> Of a great and solemn Fraternitie."

To compare them to the unhappy organizations of which laboring-men to-day are the coerced victims—wherein the ignorance of the honest wage-worker is used to deplete his small earnings for the support of vile "master-workmen" and "walking delegates" who toil not, neither spin—and the artificer in brass or iron of mediæval times (who kept his apprentices in his own household as a part of his family, to succeed him as a mas-

ter of his trade and as a member of his guild) with the modern "knight of labor," who will not that any should toil for bread who has not first paid a tax to his "lodge" or "headquarters" or camp—is to insult the guild of the middle ages and its master. But, for all that, the guild and the trades-union are nearer in theory and in practice than the guild and the modern business corporation as chartered in any known quarter of the civilized world to-day. One thing, however, there was in those middle ages, of which, happily for Mr. Hudson and his kind, no analogy has survived—namely, statutes against heresy and seditious utterances, and capital punishments, such as disemboweling, the axe, fagot, etc., for the stirrer-up of discord and unreasonable public discontent. So much for feudalism and the guilds.

Mr. Hudson's next sentence is a long one, and it reads heroically: "It is the almost universal plea, in mitigation for this infraction of economic law, that the capital engaged in combination can not earn fair profits if competition is allowed free play. But what constitutes the just measure of reward for capital? What are the fair profits for capital seeking investment in bonds, mortgages, or loans on commercial paper? The rate of interest that is fixed by free competition. What is the just measure of returns on capital invested in houses, stores, farms, small manufactures, or a thousand other forms of ordinary enterprise? Free competition. What, indeed, is the force which fixes the rate of wages, despite efforts of labor organizations to oppose combination to the action of that force, and notwithstanding the violence provoked where these organizations are brought into conflict with the great combinations of capital? The competition of labor for wages. But the result of combination is to establish, for a favored class of capital, by means of the control of the highways of commerce, an exemption from the force which fixes the just reward of all other human effort, so that excessive profits can be exacted from the masses, to be counted by the tens of millions annually; and if the ideal of railway pooling could be attained, this policy would impose upon the nation a burden of fictitious capital three times the amount of the national debt!"

The term "free competition" in the above, as we have shown, means "forced competition" (at least it means that if the remainder of Mr. Hudson's paper means anything). A and B must compete, whether they will or no: the moment they combine and become A & B, or A, B & Co., or The A and B Manufacturing Company, they are a public calamity and a standing threat to our free institutions! The reader will notice also that labor organizations are law-abiding, peaceful, and highly creditable organizations, unless unhappily "brought into conflict with the

great combinations of capital," in which case, of course, the broken heads and boycotts are the fault of the great combinations. (Query: What "great combination of capital" was at fault in the case of the poor widow whose bakery business was broken up in this city recently because she kept a journeyman baker who did not happen to be a member of a particular boycotters' union which was "competing for labor" in the vicinity of her bake-shop?) A few other simple negations are necessary in disposing of the above sentence—namely: There is no such thing as "the rate of interest" that is "fixed by free competition." The rates of interest are fixed by the laws of demand and supply in the mercantile world, and by statute so far as courts and legal proceedings are concerned. Labor does not, even when wicked capital combines, compete for wages. It appears to be oftener the rule, nowadays, that wages compete for labor; and finally, the combination or centralizing of capital is not an infraction of economic law at all; nor are any one of the above statements we have been at the pains to contradict ever offered as a "plea" or as "pleas" for such an infraction. As to what the "competition of labor for wages" is at the present date, we may illustrate by a single example. Last summer the workmen in a sugar-refinery in Brooklyn struck for an advance in wages. The proprietor called them together, showed them his books, explained to them his expenses, and demonstrated to them that if he paid them the wages demanded, his sugar would cost him more than the market price at which imported sugars were that moment selling in New York city, and that, therefore, he not only could not compete with the imported sugar, but must close his refinery. The "walking delegate," however, had his orders: the strike could not be "off." The rates must be paid; and so the refinery was closed. But, in this Mr. Hudson perceives nothing but justice. Having declined to see that the laws of supply and demand have anything to do with prices, why should they stand in the way of a capitalist paying what wages his "competing workmen" demand? The owner of the Brooklyn refinery was one of the "favored class of capital," who, "by means of the control of the highways of commerce" (the refinery in question stands on the dock, and ocean-going vessels load and discharge at its hatches), "establish an exemption from the force which fixes the reward of human effort." But in this case some force (whether that of the "walking delegate" or of the laws of commerce, or of the New York market) closed his refinery, nevertheless. The workmen who refused to keep their contracts of employment with the sugar-refiner—nay (for such the facts were), threatened to break his machinery and burn and pillage his establishment—and who, by force and arms, kept

other workmen from taking their places, were in reality honest, well-meaning, law-abiding citizens! But they had unhappily been "brought into conflict with great combinations of capital," and Mr. Hudson's arguments are not answerable for the result. You and I have a perfect right to use our means to manufacture sugar or to mine for coal, or to add to the prosperity and wealth of our community by adding to our own by employing it in any industry we may elect for. But we must be careful not to stand in the highway where "the competition of labor for wages" may be perchance brought into our vicinity. For that competition might happen to run up against us, and so be brought into conflict with us, and thereby "violence" might be "provoked." And then, if our business is ruined and our property destroyed, Mr. Hudson is not responsible—we had fair warning! Mr. Hudson can fill his pages with any doctrines it pleases him to invent, and find publishers for them; but he will not pay us for our smoking factories and broken machinery. That is our affair, not Mr. Hudson's.

Mr. Huxley somewhere speaks of gentlemen who put their statements "into italics as the queen puts her soldiers into bear-skin caps, to make them look formidable." Mr. Hudson puts his statements into figures for the same paramount purpose. His picture of the bloated capitalists, by combinations extracting from the masses a sum three times as large as the national debt, is appalling, to be sure. And were this not sufficiently appalling, he adds to it the following dazzling array: "Let us suppose, for the sake of the argument, that the abolition of competition will return a certain proportion of the enhanced profits to the workingman in the shape of increased wages. If the anthracite-coal pool raises the price of coal fifty cents per ton, and gives the miners ten cents of the advance, a gain of $3,000,000 is secured in the annual wages of the miners; but a burden of $15,000,000 is imposed on the labor that consumes the coal. If the coke syndicate raises its price fifty cents per ton, and gives its workingman ten cents advance, the advantage to labor at the coke-ovens is $400,000 in a year; but a loss of many times the amount is inflicted on labor in the various forms in which that product finally reaches the consumer. If the same operation were repeated by combinations controlling every industry and every staple of consumption, what would be the result? An addition would be made to the cost of life, of which one fifth would be given back to labor in the form of increased wages, and four fifths would be drawn from labor to swell the profits of capital. Change the proportion to whatever form you like, the fact remains that all these combinations are organized to increase the profits of the capital

engaged in them; and the increase must either be drawn from the pockets of consumers or extracted from the wages of laborers."—(Page 286.)

Monstrous! The idea of a combination being organized to increase its profits! What an example to the youth of America! What utter demoralization would ensue did it become the habit of our citizens generally to go into trade to increase their profits! Let every statesman, every economist, every preacher in the land, impress upon this generation rather the duty of every man to go into trade for the good of somebody else, and to continue therein to lessen, not to increase, his worldly store! Let him run his business, his warehouse, his factory, his steamships and railroads at a loss, and, the moment he finds his transactions profitable, let him wind up, lest he should "swell the profit of capital"; and if he will not, let the law, or Mr. Hudson, see to it.

So long as the tendency of the products of the earth is to find a market, just so long will it be the tendency within that market for the handling of different classes of products to centralize, until corn and grain are handled in one locality, pork and packed provisions in another, fruits in another, hides and pelts and leather in another. Here is natural law, and here is Mr. Hudson, too, demonstrating the imminent danger to the United States from the normal operation of this natural law. There is, of course, but one remedy for all this (though Mr. Hudson, indeed, fails to point it out), namely, a strong centralized, paternal government like that of the late Brigham Young, who walked in and out among his people, encouraging them in their efforts to amass fortunes; and then, when the fortunes were amassed, receiving heavenly visions instructing the "sealing" of those fortunes to himself! Such a governmental paternity, to be sure, might answer Mr. Hudson's purposes in confiscating the accretions of private capital. But it is difficult to see how otherwise than under just such a particular state we could enjoy the reforms he seeks.

Whenever it shall appear, or come to pass, that the interests of consumers (that is, of the people) are imperiled by the methods which the ramifications of modern civilization impose upon commerce and the operations of trade, it may come within the constitutional jurisdiction of Congress to inquire into and abridge those methods. But until such time shall come is it not, or ought it not to be, a question whether gentlemen who assume to deal with economic questions do not owe some duty to their country—not the old Greek idea of patriotism, perhaps, but still a duty—and whether that duty might not properly consist in declining to supply specious and sophistical propositions to become fire-brands in the grasp of poverty and of ignorance?

A GREAT CONFESSION.

By THE DUKE OF ARGYLL.

AMONG the many distinguished men who have contributed to the world's plebiscite in favor of the Darwinian hypothesis on the origin of species, there is no one name more distinguished than that of Mr. Herbert Spencer. He has pursued the idea of development with wonderful ingenuity through not a few of its thousand ramifications. He has carried it into philosophy and metaphysics. He has clothed it in numerous and subtle forms of speech, appealing to various faculties, and offering to each its appropriate objects of recognition. He is the author of that other phrase, "the survival of the fittest," which has almost superseded Darwin's own original phrase of "natural selection." Nothing could be happier than this invention for the purpose of giving vogue to whatever it might be supposed to mean. There is a roundness, neatness, and compactness about it, which imparts to it all the qualities of a projectile with immense penetrating power. It is a signal illustration of itself. It is the fittest of all phrases to survive. There is a sense of self-evident truth about it which fills us with satisfaction. It may perhaps be suspected sometimes of being a perfect specimen of the knowledge that puffeth up, because there is a suggestion about it—not easily dismissed—that it is tautological. The survival of the fittest may be translated into the survival of that which does actually survive. But the special power of it lies in this, that it sounds as if it expressed a true physical cause. It gets rid of that detestable reference to the analogies of mind which are inseparably associated with the phrase of natural selection. It is the great object of all true science—as some think—to eliminate these, and if possible to abolish them. Survival of the fittest seems to tell us not only of that which is, but of that which must be. It breathes the very air of necessity and of demonstration. Among the influences which have tended to popularize the Darwinian hypothesis, and to give it the imposing air of a complete and satisfactory explanation of all phenomena, it may well be doubted whether anything has been more powerful than the universal currency of this simple formula of expression.

Such is the authority who has lately contributed to this Review two papers upon "The Factors in Organic Evolution." The very title is significant. The survival of the fittest is a cause which after all does not stand alone. It is not so complete as it has been assumed to be. There are in organic evolution

more elements than one. There is concerned in it not one cause but a plurality of causes. A "factor" is specially a doer. It is that which works and does. It is a word appropriated to the conception of an immediate, an efficient cause. And of these causes there are more than one. Neither natural selection nor survival of the fittest is of itself a sufficient explanation. They must be supplemented. There are other factors which must be admitted and confessed.

This is the first and most notable feature of Mr. Spencer's articles. But there is another closely connected with it, and that is the emphatic testimony he bears to the fact that the existing popular conception is unconscious of any defect or failing in the all-sufficiency of the Darwinian hypothesis. He speaks of the process brought into clear view by Mr. Darwin, and of those with whom he is about to argue, as men "who conclude that taken alone it accounts for organic evolution."* In order to make his own coming contention clearer, he devises new forms of expression for defini g acurately the hypothesis of Darwin. He calls it "the natural selection of favorable variations." Again and again he emphasizes the fact that these variations, according to the theory, were "spontaneous," and that their utility was only "fortunate," or, in other words, accidental. He speaks of them as "fortuitously arising";† and it is of this theory, so defined and rendered precise, that he admits that it is now commonly supposed to have been "the sole factor" in the origin of species.

It is surely worth considering for a moment the wonderful state of mind which this declaration discloses. When Mr. Herbert Spencer here speaks of the "popular" belief, he is not speaking of the mob. He is not referring to any mere superstition of the illiterate multitude. He is speaking of all ranks in the world of science. He is speaking of some overwhelming majority of those who are investigators of Nature in some one or other of her departments, and who are supposed generally to recognize as a cardinal principle in science, that the reign of law is universal there—that nothing is fortuitous—that nothing is the result of accident. Yet Mr. Herbert Spencer represents this great mass and variety of men as believing in the preservation of accidental variations as "the sole factor," and as the one adequate explanation in all the wonders of organic life.

Nor can there be any better proof of the strength of his impression upon this subject than to observe his own tone when he ventures to dissent. He speaks, if not literally with bated breath, yet at least with a deferential reverence for the popular

* Page 570. ("Popular Science Monthly," vol. xxviii, p. 759.)
† Page 575. ("Popular Science Monthly," vol. xxviii, p. 765.)

dogma, which is really a curious phenomenon in the history of thought. "We may fitly ask," he says, whether it "accounts for" organic evolution. "On critically examining the evidence," he proceeds, "we shall find reason to think that it by no means explains all that has to be explained." And then follows an allusion of curious significance. "Omitting," says Mr. Spencer, "for the present any consideration of a factor which may be distinguished as primordial—"* Here we have the mind of this distinguished philosopher confessing to itself—as it were in a whisper and aside—that Darwin's ultimate conception of some primordial "breathing of the breath of life" is a conception which can only be omitted "for the present." Meanwhile he goes on with a special, and it must be confessed a most modest, suggestion of one other "factor" in addition to natural selection, which he thinks will remove many difficulties that remain unsolved when natural selection is taken by itself. But while great interest attaches to the fact that Mr. Herbert Spencer does not hold natural selection to be the sole factor in organic evolution, it is more than doubtful whether any value attaches to the new factor with which he desires to supplement it. It seems unaccountable indeed that Mr. Herbert Spencer should make so great a fuss about so small a matter as the effect of use and disuse of particular organs as a separate and a newly recognized factor in the development of varieties. That persistent disuse of any organ will occasion atrophy of the parts concerned, is surely one of the best established of physiological facts. That organs thus enfeebled are transmitted by inheritance to offspring in a like condition of functional and structural decline, is a correlated physiological doctrine not generally disputed. The converse case—of increased strength and development arising out of the habitual and healthy use of special organs, and of the transmission of these to offspring—is a case illustrated by many examples in the breeding of domestic animals. I do not know to what else we can attribute the long, slender legs and bodies of greyhounds so manifestly adapted to speed of foot, or the delicate powers of smell in pointers and setters, or a dozen cases of modified structure effected by artificial selection.

But the most remarkable feature in the elaborate argument of Mr. Spencer on this subject is its complete irrelevancy. Natural selection is an elastic formula under which this new "factor" may be easily comprehended. In truth, the whole argument raised in favor of structural modification arising out of functural use and disuse, is an argument which implies that Mr. Spencer has not himself entirely shaken off that interpretation of natural selection which he is disputing. He treats it as

* Page 570. ("Popular Science Monthly," vol. xxviii, p. 759.)

if it were the definite expression of some true physical and efficient cause, to which he only claims to add some subsidiary help from another physical cause which is wholly separate. But if natural selection is a mere phrase, vague enough and wide enough to cover any number of the physical causes concerned in ordinary generation, then the whole of Mr. Spencer's laborious argument in favor of his "other factor" becomes an argument worse than superfluous. It is wholly fallacious in assuming that this "factor" and "natural selection" are at all exclusive of, or even separate from, each other. The factor thus assumed to be new is simply one of the subordinate cases of heredity. But heredity is the central idea of natural selection. Therefore natural selection includes and covers all the causes which can possibly operate through inheritance. There is thus no difficulty whatever in referring it to the same one factor whose solitary dominion Mr. Spencer has plucked up courage to dispute. He will never succeed in shaking its dictatorship by such a small rebellion. His little contention is like some bit of Bumbledom setting up for Home Rule—some parochial vestry claiming independence of a universal empire. It pretends to set up for itself in some fragment of an idea. But here is not even a fragment to boast of or to stand up for. His new factor in organic evolution has neither independence nor novelty. Mr. Spencer is able to quote himself as having mentioned it in his "Principles of Biology" published some twenty years ago; and by a careful ransacking of Darwin he shows that the idea was familiar to and admitted by him at least in his last edition of the "Origin of Species." Mr. Spencer insists that this fact is evidence of a "reaction" in Darwin's mind against the sole factorship of natural selection. Darwin was a man so much wiser than all his followers, and there are in his book so many indications of his sense of our great ignorance, that most probably he did grow in the consciousness of the necessary incompleteness and shortcomings of his own explanations. But there was nothing whatever to startle him in the idea of heredity propagating structural change, through functional use and disuse. This idea was not incongruous with his own more general conception. On the contrary, it was strictly congruous and harmoniously subordinate. He did not profess to account for all the varieties which emerge in organic forms. Provisionally, and merely for the convenience of leaving that subject open, he spoke of them as fortuitous. But to assume the really fortuitous or accidental character of variation to be an essential part of this theory, is merely one of the many follies and fanaticisms of his followers.

Although, therefore, the particular case chosen by Mr. Herbert Spencer to illustrate the incompetency of natural selection,

taken alone, to explain all the facts of organic evolution, is a case of little or no value for the purpose, yet the attitude of mind into which he is thrown in the conduct of his argument leads him to results which are eminently instructive. The impulse "critically to examine" such a phrase as "natural selection" is in itself an impulse quite certain to be fruitful. The very origin of that impulse gives it of necessity right direction. Antagonism to a prevalent dogma so unreasoning as to set up such a mere phrase as the embodiment of a complete philosophy, is an antagonism thoroughly wholesome. Once implanted in Mr. Herbert Spencer's mind, it is curious to observe how admirably it illustrates the idea of development. Having first sought some shelter of authority under words of the great prophet himself, he becomes more and more aggressive against the pretenders to his authority. His grumbles against them become loud and louder as he proceeds. He speaks of "those who have committed themselves to the current exclusive interpretation."* He observes upon "inattention and reluctant attention" as leading to the ignoring of facts. He speaks of "alienation from a belief" as "causing naturalists to slight the evidence which supports that belief, and refuse to occupy themselves in seeking further evidence." He compares their blindness now respecting the insufficiency of natural selection with the blindness of naturalists to the facts of evolution before Darwin's book appeared. He marshals and reiterates the obvious considerations which prove that the development of animal forms must necessarily depend on an immense number and variety of adjusted changes in many different organs, all co-operating with each other, and all nicely adjusted to the improved functional actions in which they must all partake. He reduces the practical impossibility of such changes occurring as the result of accident to a numerical computation. He tells his opponents that the chances against any adequate readjustments fortuitously arising "must be infinity to one."† But more than this: he not only repels the Darwinian factor as adequate by itself, but, advancing in his conclusions, he declares that it must be eliminated altogether. On further consideration he tells us that in his opinion it can have neither part nor lot in this matter. He insists that the correlated changes are so numerous and so remote that the greater part of them can not be ascribed (even) in any degree to the mere selection of favorable variations.‡ Then facing the opponents whose mingled credulities and incredulities he has so offended, he rebukes their fanaticisms according to a well-known

* Page 581. ("Popular Science Monthly," vol. xxviii, p. 770.)
† Page 571. ("Popular Science Monthly," vol. xxviii, p. 765.)
‡ Page 574. ("Popular Science Monthly," vol. xxviii, p. 761.)

formula: "Nowadays," he says, "most naturalists are more Darwinian than Mr. Darwin himself." * This is most true; and Mr. Herbert Spencer need not be the least surprised. All this happens according to a law. When a great man dies, leaving behind him some new idea—new either in itself or in the use he makes of it—it is almost invariably seized upon and ridden to the death by the shouting multitudes who think they follow him. Mr. Herbert Spencer here directs upon their confusions the searching light of his analysis. He most truly distinguishes Darwin's hypothesis in itself, first from the theory of "organic evolution in general," and secondly from "the theory of evolution at large." This analysis roughly corresponds with the distinctions I have pointed out in the preceding paper; and when he points to the confounding of these distinctions under one phrase as the secret of wide delusions, he has got hold of a clew by which much further unraveling may be done. Guided by this clew, and in the light of this analysis, he brings down Darwin's theory to a place and a rank in science which must be still further offensive to those whom he designates as the "mass of readers." He speaks of it as "a great contribution to the theory of organic evolution." It is in his view a "contribution," and nothing more—a step in the investigation of a subject of enormous complexity and extent, but by no means a complete or satisfactory solution of even the most obvious difficulties presented by what we know of the structure and the history of organic forms.

It is no part of my object in this paper to criticise in detail the value of that special conception with which Mr. Herbert Spencer now supplements the deficiencies of the Darwinian theory. He calls it "inheritance of functionally produced modifications," and he makes a tremendous claim on its behalf. He evidently thinks that it supplies not only a new and wholly separate factor, but that it goes a long way toward solving many of the difficulties of organic evolution. Nothing could indicate more strongly the immense proportions which this idea has assumed in his mind than the question which he propounds toward the conclusion of his paper. Supposing the new factor to be admitted, "do there remain," he asks, "no classes of organic phenomena unaccounted for?" Wonderful question, indeed! But at least it is satisfactory to find that his reply is more rational than his inquiry: "To this question, I think it must be replied that there do remain classes of organic phenomena unaccounted for. It may, I believe, be shown that certain cardinal traits of animals and plants at large are still unexplained"; and so he proceeds to the second paper, in which the still refractory residuum is to be reduced.

* Page 584. ("Popular Science Monthly," vol. xxviii, p. 773.)

Whatever other value may attach to an attempt so ambitious, it is at least attended with this advantage, that it leads Mr. Herbert Spencer to follow up the path of "further consideration" into the phrases and formulæ of the Darwinian hypothesis. And he does so with memorable results. What he himself always aims at is to obliterate the separating lines between the organic and the inorganic, and to reduce all the phenomena of life to the terms of such purely physical agencies as the mechanical forces, or as light, heat, and chemical affinity, etc. In this quest he finds the Darwinian phrases in his way. Accordingly, although himself the author and inventor of the most popular among them, he turns upon them a fire of most destructive criticism. He allows them to be, or to have been, "convenient and indeed needful"* in the conduct of discussion, but he condemns them as "liable to mislead us by veiling the actual agencies" in organic evolution. That very objection which has always been made against all phrases involving the idea of creation—that they are metaphorical—is now unsparingly applied to Darwin's own phrase "natural selection." Its "implications" are pronounced to be "misleading." The analogies it points at are indeed definite enough, but unfortunately the "definiteness is of a wrong kind." "The tacitly implied 'nature' which selects, is not an embodied agency analogous to the man who selects artificially." This cuts down to the very root of the famous formula, and to that very element in it which has most widely commended it to popular recognition and acceptance. But this is not all. Mr. Herbert Spencer goes, if possible, still deeper down, and digs up the last vestige of foundation for the vast but rambling edifice which has been erected on a phrase. The special boast of its worshipers has always been that it represented and embodied that great reform which removed the processes of organic evolution once and forever from the dominion of deceptive metaphor, and founded them for the first time on true physical causation. But now Mr. Herbert Spencer will have none of this. The whole of this pretension goes by the board. He pronounces upon it this emphatic condemnation: "The words natural selection do not express a cause in the physical sense."† It is a mere "convenient figure of speech."‡

But even this is not enough to satisfy Mr. Spencer in his destructive criticism. He goes himself into the confessional. He had done what he could to amend Darwin's phrase. He had "sought to present the phenomena in literal terms rather than metaphorical terms," and in this search he was led to "survival

* Page 749. ("Popular Science Monthly," vol. xxix, p. 55.)

† Ibid.

‡ Page 750. ("Popular Science Monthly," vol. xxix, p. 55.)

of the fittest." But he frankly admits that "kindred objections may be urged against the expression," to which this leading led him. The first of these words in a vague way, and the second word in a clear way, call up an idea which he must admit to be "anthropocentric." What an embarrassment it is that the human mind can not wholly turn the back upon itself! Self-evisceration, the happy dispatch of the Japanese, is not impossible or even difficult, although when it is done the man does not expect to continue in life. But self-evisceration by the intellectual faculties is a much more arduous operation, especially when we expect to go on thinking and defining as before. It is conceivable that a man might live at least for a time without his viscera, but it is not conceivable that a mind should reason with only some bit or fragment of the brain. In the mysterious convolutions of that mysterious substance there are, as it were, a thousand retinæ—each set to receive its own special impressions from the external world. They are all needed; but they are not all of equal dignity. Some catch the lesser and others catch the higher lights of nature; some reflect mere numerical order or mechanical arrangement, while others are occupied with the causes and the reasons and the purposes of these. Some philosophers make it their business to blindfold the facets which are sensitive to such higher things, and to open those only which are adapted to see the lower. And yet these very men generally admit that the faculties of vision which see the higher relations are peculiarly human. They are so identified with the human intellect that they can hardly be separated. And hence they are called anthropomorphic, or as Mr. Spencer prefers to call them "anthropocentric." This close association—this characteristic union—is the very thing which Mr. Spencer dislikes. Yet the earnest endeavors of Mr. Spencer to get out of himself—to eliminate every conception which is "anthropocentric"—have very naturally come to grief. "Survival"? Does not this word derive its meaning from our own conceptions of life and death? Away with it, then! What has a true philosopher to do with such conceptions? Why will they intrude their noxious presence into the purified ideas of a mind seeking to be freed from all anthropocentric contamination? And then that other word "fittest," does it not still more clearly belong to the rejected concepts? Does it not smell of the analogies derived from the mortified and discarded members of intelligence and of will? Does it not suggest such notions as a key fitting a lock, or a glove fitting a hand, and is it worthy of the glorified vision we may enjoy of Nature to think of her correlations as having any analogy with adjustments such as these? In the face of the innumerable and complicated adjust-

ments of a purely mechanical kind which are conspicuous in organic life, Mr. Spencer has the courage to declare that "no approach" to this kind of fitness "presentable to the senses" is to be found in organisms which continue to live in virtue of special conditions. Where materials are so abundant it is hard to specify. But I am tempted to ask whether Mr. Spencer has ever heard of the ears, the teeth, above all the finger of the aye-aye, the wonderful beast that lives in the forest of Madagascar, and is very nicely fitted indeed to prey upon certain larvæ which burrow up the pith of certain trees? Here we see examples of fitting in a sense as purely mechanical as he could possibly select from human mechanism. The enormous ears are fitted to hear the internal and smothered raspings of the grub. The teeth are fitted for the work of cutting-chisels, while one finger is reduced to the dimension of a mere probe, armed with a hooked claw to extract the larvæ. The fitting of this finger-probe into the pith-tube of the forest bough is precisely like the fitting of a finger into a glove. It is strange indeed that Mr. Spencer should deny the applicability of the word fitness, in its strictest "glove" sense, to adaptations such as these. Yet he does deny it in words emphatic and precise. Neither the organic structures themselves—he proceeds to say—nor their individual movements are related in any analogous way to the things and actions in the midst of which they live. Having made this marvelous denial, he reiterates in another form his great confession—his *gran rifiuto*—that his own famous phrase, although carefully designed to express self-acting and automatic physical operations, is, after all, a failure. And this result he admits not only as proved, but as obviously true. His confession is a humble one. "Evidently," he says, "the word fittest as thus used is a figure of speech."*

This elaborate dissection and condemnation by Mr. Herbert Spencer of both the two famous phrases which have been so long established in the world as expressing the Darwinian hypothesis —his emphatic rejection of the claim of either of them to represent true physical causation—his sentence upon both of them that they are mere figures of speech—is, in my judgment, a memorable event. As regards Mr. Spencer himself, it is a creditable performance and an honorable admission. It is one of the high prerogatives of the human mind to be able to turn upon its own arguments, and its own imaginings, the great weapon of analysis. There are in all of us, not only two voices, but many voices, and splendid work is done when the higher faculties call upon the lower to give an account of what they have said and argued. Often and often, as the result of such a call, we should

* Page 751. ("Popular Science Monthly," vol. xxix, p. 56.)

catch the accents of confession saying: "We have been shutting our eyes to the deepest truth, keeping them open only to others which were comparatively superficial. We have been trying to conceal this by the invention of misleading phrases—full of loose analogies, of vague and deceptive generalities."

Most unfortunately, however, the special peculiarity of Mr. Spencer's introspection appears to be that it is the lower intellectual faculties which are calling the higher to account. The merit of Darwin's phrase lay in its elasticity—in its large elements of metaphor taken from the phenomena of mind. Mr. Spencer's phrase had been carefully framed, he tells us, to get rid of these. His great endeavor was to employ in the interpretation of Nature only those faculties which see material things and the physical forces. Those other faculties which see the adjustments of these to purpose—to the building up of structures yet being imperfect, and to the discharge of functions yet lying in the future—it was his desire to exclude or silence. This was his aim, but he now sees that he has failed. In spite of him the higher intellectual perceptions have claimed admittance, and have actually entered. He now calls on the humbler faculties to challenge this intrusion, and to assert their exclusive right to occupy the field. The "survival of the fittest" had been constructed to be their fortress. But the very stones of which it is built—the very words by which the structure is composed—are themselves permeated with the insidious elements which they were intended to resist. The "survival of the fittest" is a mere redoubt open at the back, or a fort which can be entered at all points from an access underground. And so, like a skillful general, Mr. Spencer has ordered a complete evacuation of the works.

But in giving up this famous phrase Mr. Spencer does not give up his purpose—which, indeed, is one of the main purposes of his philosophy—namely, to build up sentences and wordy structures which shall eliminate, as far as it is possible to do so, all those aspects of natural phenomena which are human, that is to say, those aspects which reflect at all an intellectual order analogous with or related to our own. "I have elaborated this criticism," he says, "with the intention of emphasizing the need for studying the changes which have gone on, and are ever going on, in organic bodies from an exclusively physical point of view."* And so, new formulæ are constructed to explain, and to illustrate how this is to be done. "Survival" suggesting the "human view" of life and death, must be dismissed. How, then, are they to be described? They are "certain sets of phenomena." Their true physical character is "simply groups of

* Page 751. ("Popular Science Monthly," vol. xxix, p. 56.)

changes." In thinking of a plant, for example, we must cease to speak of its living or dying. "We must exclude all the ideas associated with the words life or death."* What we do know, physically, is thus defined: "That there go on in the plant certain interdependent processes in presence of certain aiding or hindering influences outside of it; and that in some cases a difference of structure or a favorable set of circumstances allows these interdependent processes to go on for longer periods than in other cases." How luminous! Milton spoke of his own blindness as "knowledge at one entrance quite shut out." But here we have a specimen of the verbal devices by which knowledge at all entrances may be carefully excluded. Life is certain "interdependent processes." Yes, certainly. But so is death. And so is everything else that we know of or can conceive. The words devised by Mr. Herbert Spencer to represent the "purely physical" view of life and death, are words which present no view at all. They are simply a thick fog in which nothing can be seen. Except in virtue of this character of general opacity, they are wholly useless for Mr. Spencer's own purpose as well as for every other. He seeks to exclude mind. But he fails to do so. He seems to think that when he has found a collocation of words which do not expressly convey some particular idea, he has therein found words in which that idea is excluded. This is not so. Words may be so vague and abstract as to signify anything or nothing. If under the word "fitness" human ideas of adjustment and design are apt to insinuate themselves, assuredly the same ideas not only may, but must, be comprehended under such a phrase as "interdependent processes." Painting, for example, is an interdependent process, and both in its execution and results its interdependence lies in purely physical combinations of visible and touchable materials. Yet Sir Thomas Lawrence spoke with literal truth when he snubbed a questioner as to the mechanics of his art by telling him that he mixed his colors with brains. The whole of chemical science consists in the knowledge of interdependent processes which are (what we call) purely physical, while the whole science of applied chemistry involves those other interdependent processes which involve the co-operation of the human mind and will.

We have, then, in this new phrase a perfect specimen of one favorite method of Mr. Herbert Spencer in his dealing with such subjects; and the weapon of analysis which he turns so successfully against his own old phrase when he wishes to abandon it, can be turned with equal success not only against all substitutes for it, but against the whole method of reasoning of which it was an example. The verbal structures of definition which

* Page 751. ("Popular Science Monthly," vol. xxix, p. 55.)

abound in his writings always remind me of certain cloud-forms which may sometimes be seen in the western sky, especially over horizons of the sea. They are often most glorious and imposing. Great lines of towers and of far-reaching battlements give the impression at moments of mountainous solidity and strength. But as we gaze upon them with wonder, and as we fix upon them a closely attentive eye, the edges are seen to be as unsteady as at first they appeared to be enduring. If we attempt to draw them we find that they melt into each other, and that not a single outline is steady for a second. In a few minutes whole masses which had filled the eye with their majesty, and with impressions as of the everlasting hills, dissolve themselves into vapor and melt away.

Such are the cloud-castles which mount upon the intellectual horizon as we scan it in the representations of the mechanical philosophy. Nothing can be more fallacious than the habit of building up definitions out of words so vague and abstract that they may signify any one of a dozen different things, and the whole plausibility of which consists in the ambiguity of their meanings. It is a habit too which finds exercise in the alternate amusement of wiping out of words which have a definite and familiar sense, everything that constitutes their force and power. Let us take, for example, the word "function." There is no word, perhaps, applicable to our intellectual apprehensions of the organic world, which is more full of meaning, or of meaning which satisfies more thoroughly the many faculties concerned in the vision and description of its facts. The very idea of an organ is that of an apparatus for the doing of some definite work, which is its function. For the very reason of this richness and fullness of meaning, in this word conjoined with great precision, it is unfitted for use in the vapory cloud-castles of definition which are the boasted fortresses of ideas purely physical. And yet function is a word which it is most difficult to dispense with. The only alternative is to reduce it to some definition which wipes out all its special signification. Accordingly, Mr. Herbert Spencer has defined function as a word equivalent to the phrase "transformations of motion"*—a phrase perfectly vague, abstract, and equally applicable to function or to the destruction of it, to the processes of death or the processes of life, to the phenomena of heat, of light, or of electricity, and completely denuded of all the special meanings which respond to our perception of a whole class of special facts.

Of course the attempt breaks down completely to describe the facts of nature in words too vague for the purpose, or in words rendered sterile by artificial eliminations. It is not Dar-

* "Principles of Biology," vol. i, p. 4.

win only, who had at least no dogma on this subject to bind him —it is Mr. Spencer himself who continually breaks down in the attempt, far more completely than he now admits he failed in the "survival of the fittest." The human element involved or suggested in the idea of fitness is nothing to the humanity, or "anthropocentricity," of the expressions into which he slips, perhaps unawares, when he is face to face with those requisites of language which arise out of the facts of observation, and out of the necessities of thought. Thus in the midst of an elaborate attempt to explain in purely chemical and physical aspects the composition and attributes of protein, or protoplasm—assumed to be the fundamental substance of all organisms—he breaks out into the following sentence, charged with teleological phraseology: "So that while the composite atoms of which organic tissues are built up possess that low molecular mobility fitting them for plastic purposes, it results from the extreme molecular mobilities of their constituents, that the waste products of vital activity escape as fast as they are formed." * Now, what is the value of sentences such as this? As an explanation, or anything approaching to an explanation, of the wondrous alchemies of organic life, and especially of the digestive processes—of the appropriation, assimilation, and elimination of external matter —this sentence is poor and thin indeed. But whatever strength it has is entirely due to its recognition of the fact that not only the organism as a whole, but the very materials of which it is "built up," are all essentially adaptations which are in the nature of "purposes," being indeed contrivances of the most complicated kinds for the discharge of functions of a very special character.

What, then, is the great reform which these new papers are intended to effect in our conception of the factors in organic evolution? The popular and accepted idea of them has been largely founded on the language of Darwin and of Mr. Spencer himself. But that language has been deceptive. The needed reform consists in the more complete expulsion of every element that is "anthropocentric." In order to interpret Nature we must stand outside ourselves. The eye with which we look upon her phenomena must be cut off, as it were, from the brain behind it. The correspondences which we see, or think we see, between the system of things outside of us and the system of things inside of us, which is the structure of our own intelligence, are to be discarded. This is the luminous conception of the new philosophy. Science has hitherto been conceived to be the reduction of natural phenomena to an intelligible order. But the reformed idea is now to be that our own intelligence is

* "Principles of Biology," vol. i, p. 24.

the one abounding fountain of error and deception. It is not merely to be disciplined and corrected, but it is to be eliminated. It is to be hounded off and shouted down.

It is very clear what all this must end in. The demand made upon us in its literal fullness is impossible and absurd. We can not stand outside ourselves. We can not look with eyes other than our own. We can not think except with the faculties of our own intellectual nature. It is impossible, and, if it were possible, it would be absurd. We are ourselves a part of nature—born in it, and born of it. The analogies which the disciplined intellect sees in external nature are therefore not presumably false, but presumably true, or at the least substantially representative of the truth.

But the new veto on anthropocentric thought, although helpless to expel it, is quite competent to cripple and degrade it. It can not exclude our own faculties; but it may select and favor the lowest, the humblest, the most elementary, the most blunt, the least perceptive. It may silence the highest, the acutest, the most penetrating, the most intuitive, those most in harmony with the highest energies in the world around us. All this the new doctrine may do, and does.

Accordingly, the very first instance given to us of the new philosophy is a striking illustration of its effects. It fixes the attention on mere outward and external things. It seeks for the first and best explanation of organic beings in the mere mechanical effects of their surroundings. The physical forces which act upon them from outside—the water or the air that bathes them—the impacts of ethereal undulations in the form of light, the vibrations of matter in contact with them in the form of heat—these are conceived of as the agencies principally concerned. The analogies suggested are of the rudest kind. Old cannon-balls rust in concentric flakes. Rocks weather into such forms as rocking stones.* But the grand illustration is taken from the pebbles of the Chesil beach.† These are to introduce us to the true physical conception of the wonderful phenomena of organic life. May not the unity of the vertebrate skeleton, through an immense variety of creatures, be typified by the roundness and smoothness common to the stones rolled along the southern beaches of England from Devonshire to Weymouth? The diversities of those creatures, again, however multitudinous in character, may they not all be pictured as analogous with the varying sizes into which water sifts and sorts the sizes of rolled stones?

But presently we see in another form the work of "natural

* Page 755. ("Popular Science Monthly," vol. xxix, p. 60.)
† Page 752. ("Popular Science Monthly," vol. xxix, p. 57.)

selection" by a mind deliberately divesting itself of its own higher faculties, and choosing in consequence to exert only those which are simple and almost infantile. The question naturally arises, What is the most universal peculiarity and distinction of organic forms? When we get rid of ourselves, when we stand outside of our own anthropocentric position, and consult only the faculties which are most purely physical, we shall be compelled to reply that the great specialty of organic forms is the "differentiation of their outside from their inside."* They have all an outside and an inside, and these are different. They begin with a cell, and a cell is a blob of jelly with a pellicle or thin membrane on the outside. Do we not see in this the mechanical action of the surrounding medium? The skin may come from a chill on the outside, or the pressure of the medium. Does not a little oil form itself into a sphere in water, or a little water into a drop in air? And so from one step to another, can not we conceive how particles of protein become cells, and how one cell gets stuck to another, and the groups to groups—all with insides and outsides "differentiated" from each other, and so they can all be pressed and compacted and squeezed together until the organism is completed?†

Such or such like are the images presented to enable us to conceive the purely physical view of the beginnings of life. Their own genesis is obvious. It is true that all or nearly all organisms have a skin. Most if not all of them begin, so far as seen by us, in a nucleated cell. The external wall of these cells is often a mere pellicle. It is true also that one essential idea of life is separation or segregation from all other things. This is an essential part of our ideas of individuality and of personality. If a pellicle or skin round a bit of protein be taken as the symbol of all that is involved in this idea of life, then "outness" and "inness" may be tolerated as a very rude image of one of the great peculiarities of all organic life. It may even be regarded as a symbol of the thoughts expressed in the solemn lines—

> "Eternal form shall still divide
> The eternal soul from all beside."

But if "outer" and "inner" are used to express the idea of some essential mechanical separation between different parts of the same organism, so that one part may be represented as more the result of surrounding forces than another—then this rude and mechanical illustration is not only empty, but profoundly erroneous. The forces which work in and upon organic life know

* Page 755. ("Popular Science Monthly," vol. xxix, p. 60.)
† Pages 756–758. ("Popular Science Monthly," vol. xxix, pp. 61–63.)

nothing of outness and inness. They shine through the materials which they build up and mold, as light shines through the clearest glass. Even the most purely physical of those concerned are independent of such relations. Gravitation knows nothing of inness and outness. The very air, which seems so external to us, does not merely bathe or lave the skin, but permeates the blood, and its elements are the very breath of life in every tissue of the body. The more secret forces of vitality deal at their will with outness and inness. The external surfaces of one stage are folded in and become most secret recesses at another. Organs which are outside in one animal, and are conspicuously flourished in the face of day with exquisite ornament of color and of structure,* are in another animal hid away and carefully covered up. Nay, there are many cases in which all these changes are conducted in the same animal at different periods of life, and during conscious and unconscious intervals the whole creature is reformed to fit it for new surroundings, for new media, and with new apparatuses adapted to them.

If Mr. Spencer wishes to cast any fresh light upon those factors of organic evolution respecting which he now confesses that Darwin's language and his own have been alike defective, he must fix our attention on something deeper than the differences between every organism and its own skin. His selection of this most superficial kind of difference as the first to dwell upon, is not merely wanting—it is erroneous. It hides and leads us off the scent of another kind of outsidedness and insidedness which is really and truly fundamental; namely, the insidedness, the self-containedness, of every organism as a whole with reference to all external forces. Nobody has pointed this out more clearly in former years than Mr. Spencer himself. The grand distinction between the organic and the inorganic lies in this—that the organic is not passive under the touch or impact of external force, but responds, if it responds at all, with the play of counter-forces which are essentially its own. Organic bodies are not simply moved. They move themselves. They have "self-mobility." † They are so constituted that even when an external force acts as an excitement or a stimulus, the organic forces which emerge and act are much more complex and important—so much so that as compared with the results produced by these organic forces the direct results of the incident forces are "quite obscured." ‡ Mr. Spencer even confesses that these two kinds of action are so different in their own nature that in strictness they "should not be dealt with together."

* As in the nudibranchiate mollusca.

† Page 757. ("Popular Science Monthly," vol. xxix, p. 62.)

‡ "Principles of Biology," vol. i, p. 43.

But he adds that "the impossibility of separating them compels us to disregard the distinction between them." This is a most lame excuse for the careless—and still worse excuse for the studied—use of ambiguous language which confounds the deepest distinctions in nature. It can not be admitted. All reasonings on nature would be hopeless unless we could separate in thought many things which are always conjoined in action; and this excuse is all the more to be rejected when the alleged impossibility of separation is used to cover an almost exclusive stress upon that one of the two kinds of action which is confessedly by far the feeblest, and of least account in the resulting work.

It seems to me, further, that there is another fatal fault in this attempt of Mr. Spencer to reform the language, and clear up the ideas of biological science. Besides the method of habitually using words so abstract as to be of necessity ambiguous—besides the further method of habitually expelling from definite words the only senses which give them value—Mr. Spencer often resorts, and does so conspicuously in this paper, to the scholastic plan of laying down purely verbal propositions and then arguing deductively from them as if they represented axiomatic truth. By the schoolmen this method was often legitimately applied to subjects which in their own nature admitted of its use, because those subjects were not physical but purely moral or religious, and in which consequently much depended on the clear expression of admitted principles of abstract truth. I will not venture to say that such verbal propositions embodying abstract ideas have absolutely no place in physical science. We know as a matter of fact that they have led some great men to the first conception of a good many physical truths; and it is a curious fact that Dr. Joule, who in our own day has been the first to establish the idea of the doctrine of the conservation of energy by proving through rigorous experiment the mechanical equivalent of heat, has said that "we might reason *a priori* that the absolute destruction of living force can not possibly take place because it is manifestly absurd to suppose that the powers with which God has endowed matter can be destroyed, any more than they can be created, by man's agency." *

Believing as I do in the inseparable unity which binds us to all the verities of nature, I should be the last to proscribe the careful use of our own abstract conceptions. But it is quite certain and is now universally admitted that the methods of Thomas Aquinas in his "Summa" are full of danger when they

* In a lecture delivered at Manchester, April 28, 1847. See "Strictures on the Sermon," etc., by B. St. J. B. Joule, J. P., a pamphlet published 1887 (J. Heywood, Manchester).

are used in physical investigation. Yet as regards at least the tone of dogma and authority, and also as regards the method of reasoning, we have from Mr. Spencer in this paper the following wonderful specimen of scholastic teaching on the profoundest questions of organic structure: "At first protoplasm *could have* no proclivities to one or other arrangement of parts; unless indeed a purely mechanical proclivity toward a spherical form when suspended in a liquid. At the outset it *must have been* passive. In respect of its passivity, primitive organic matter *must have been* like inorganic matter. No such thing as spontaneous variation *could have* occurred in it; for variation implies some habitual course of change from which it is a divergence, and is therefore excluded where there is no habitual course of change." What possible knowledge can Mr. Spencer possess of "primitive organic matter"? What possible grounds can he have for assertions as to what it *must have been*, and what it *must have done?* Surely this is scholasticism with a vengeance; its words, its assumptions, and its claims of logical necessity being all equally hazy, inconclusive, and absolutely antagonistic to the spirit of true physical science.

There is a passing sentence in one of Darwin's works* which will often recur to the memory of those who have observed it. Speaking of the teleological or theological methods of describing nature, he says that these can be made to explain anything. At first sight this may seem a strange objection to any intelligible method—that it is too widely applicable. But Darwin's meaning is in its own sphere as true as it is important. An explanation which is good for everything in general, is good for nothing in particular. Explanations which are indiscriminate can hardly be also special and distinguishing. In their very generality they may be true, but the truth must be as general as the terms in which it is expressed. Thus the common phrase which we are in the habit of applying to the wonderful adaptations of organic life when we call them "provisions of nature," is a phrase of this kind. It satisfies certain faculties of the mind, and these the highest, but it affords no satisfaction at all to those other faculties which ask not why, but how, these adaptations are effected. It is an explanation applicable to all adaptations equally, and to no one of them specially. It takes no notice whatever of the question, How? It does not concern itself at all with physical causes.

Darwin saw this clearly of such methods of explanation. But he did not see that precisely the same objection lies against his own. The great group of ideas metaphorically involved in his phrase of natural selection, and not successfully eliminated in

* I have mislaid the reference, and quote from memory.

the summary of it—survival of the fittest—is a group of the widest generality. It may be used to account for anything. The successful application of it to any organic adaptation, however special and peculiar, is so easy as to become a mere trick. We have only to assume the introduction of some primordial organisms—one or more—already formed with all the special powers and functions of organic life; we have only to assume the inscrutable action of heredity; we have only to assume, further, that it originates difference as well as transmits likeness; we have only to assume, still further, that the variations so originated are almost infinite in variety, and that some of them are almost sure, at some time or another, to "turn up trumps," or in other words to be accidentally in a useful direction; we have only to assume, again, that these will be somehow continued and developed through embryotic stages until they are fit for service; we have only to assume, again, that there are adjustments by which serviceability, when transmuted into actual use, has power still further to improve all adaptations by some process of self-edification; then, making all these assumptions, we may explain anything and everything in the organic world. But in such a series of assumptions we do not speak the language of true physical causation. This is what Mr. Spencer now confesses. "Natural selection," he says, "could operate only under subjection."* This is a prolific truth. It might have been discovered sooner. Natural selection could only select among things prepared for and presented to its choice. How—from what physical causes—did these come? Mr. Spencer's reply is, historically speaking, retrograde. He goes back to Lamarck, he reverts to "use and disuse," to "environment"—to surroundings—to the "medium and its contents."† These again are mere phrases to cover the nakedness of our own ignorance. But I for one am thankful for the conclusion arrived at by a mind so acute and so analytical as that of Mr. Spencer, that "among biologists the beliefs concerning the origin of species have assumed too much the character of a creed, and that while becoming settled they have been narrowed. So far from further broadening that broader view which Darwin reached as he grew older, his followers appear to have retrograded toward a more restricted view than he ever expressed." The evil must have gone far indeed when this great apostle of Evolution has to plead so laboriously and so humbly "that it is yet far too soon to close the inquiry concerning the causes of organic evolution." Too soon indeed! That such an assumption should have been possible, and that it is virtually made, is part of the Great Confession to which I have desired to direct attention. I hope it

* Page 768. ("Popular Science Monthly," vol. xxix, p. 201.) † Ibid.

will tend to redeem the work of the greatest natural observer who has ever lived from the great misuse which has been often made of it. There is no real disparagement of that work in saying that the phrase which embalmed it is metaphorical. The very highest truths are conveyed in metaphor. The confession of Mr. Spencer is fatal only to claims which never ought to have been made. Natural selection represents no physical causation whatever except that connected with heredity. Physically it explains the origin of nothing. But the metaphorical elements which Mr. Spencer wishes to eliminate are of the highest value. They refer us directly to those supreme causes to which the physical forces are "under subjection." They express in some small degree that inexhaustible wealth of primordial inception, of subsequent development, and of continuous adjustment, upon which alone selection can begin to operate. These are the supreme facts in nature. When this is clearly seen and thoroughly understood, Darwin's researches and speculations will no longer act as a barrier to further inquiry, as Mr. Spencer complains they now do. They will, on the contrary, be the most powerful stimulus to deeper inquiry, and to more healthy reasoning.—*Nineteenth Century.*

THE AMERICAN ROBIN AND HIS CONGENERS.

By Dr. SPENCER TROTTER.

OUR American robin is a thrush—the red-breasted thrush is his proper title—he occupies a high position in the scale of bird-life, and possesses some very interesting records of his family history. When our forefathers first came over they found the frank, hearty bird with the russet breast ready to make friends with them, to stay about the clearings and around their rough cabins, cheering them with the strong, hopeful song that has ever gladdened the heart with its vigor and fullness of promise. With what joy the pioneers must have welcomed the first spring that brought the robins back after the long, dreary winter! To this day the first robin of the spring creates a sensation, coming, as he often does, amid the ice and the snow and the rough wind, and not a leaf on the trees. The early settlers called him "robin" from his red breast, no doubt, and his confiding ways, after the trusty little warbler so dear to their hearts in the old home across the sea. And so it has been "robin" ever since, although our bird is but distantly related to the little robin-redbreast of the Old World, who belongs to the warblers —another branch of the family.

By virtue of being a thrush, our robin enjoys a very extensive range of country for his habitat. From the Atlantic to the Pacific, across the continent, from the shores of the Arctic Ocean to Mexico and Central America, he is found abundantly, breeding throughout the forest limits of this wide area, and building the same nest of dried grass, roots, and plastered mud about every homestead in the land. Although a bird of the woodland, like all the thrushes, he yet prefers the garden and the orchard —even the trees that stand in the midst of the bustling city hold his nest. Insectivorous by nature, but varying his diet largely with the small, wild berries of the woods, the robin has become, since man's invasion, a lover of fruit, keeping pace with man in the cultivation of his taste. The excellence of his taste can not be denied. He takes the biggest cherries of the most approved varieties, and the luscious strawberries are his delight. Yet for all the fruit he eats he repays the horticulturist double by devouring threefold more of insect-life that would ultimately cover and destroy the trees, leaf, root, and branch. Fortunate it is that we have recognized his valuable service, and protected him by legislation.

AMERICAN ROBIN.

The true thrushes—and the robin may be taken as a type—present some very interesting features in their development, characters, and geographical distribution, a study of which throws light not only upon the history of the birds themselves, but also upon several widely different subjects.

The thrushes belong to the most highly organized group of birds—the *Passeres*—and are farthest removed in structure from the early reptiloid forms. They possess the most complete vocal apparatus—a syrinx—situated at the lower end of the windpipe, with five intrinsic pairs of muscles. The wing has undergone a reduction in the number of its primaries or quill-feathers growing from the long finger, there being ten of these, the first one short and abortive, so that the thrushes may be looked upon as still advancing toward the highest type of wing-structure, that of *nine* primaries. In conjunction with this, the foot or leg is "booted"—i. e., covered by an unbroken plate of hard, leathery skin, not reticulated and scaled, as in other forms. A decided change has also taken place in the "molt," or shedding of

feathers; the autumnal molt being the only complete process, while the spring change is effected simply by the "casting" off of the broken points of feathers in the worn plumage. The young of all the thrushes are spotted in their nestling dress, but never carry it beyond the first autumn, assuming the full plumage of the old birds after the first molt, so that "a bird of the year" in the late fall and winter is scarcely distinguishable from its parents. Any one who is familiar with the young robins hopping about the lawn in the early summer, with their spotted breasts and mottled backs, may have wondered what became of them by October.

The thrushes are migratory birds in the temperate zone, as the nature of their food demands, partaking in the general north and south movement during the spring and fall tides of migration. Though not strictly gregarious, many of the species associate in loose flocks, on the approach of autumn, and forage over the country in quest of food. We are all familiar with the flocks of robins in the fall, scattering overhead, or in the gum-trees feasting on the ripe, black fruit. They are for the most part arboreal, living largely among the trees, but some of the species build nests on the ground, or in the undergrowth just above it, and all of them frequent the ground at times when food is to be obtained there. Being among the most highly organized of birds, the thrushes are consequently rapid livers, possessing a high degree of vitality, and consuming a very large proportion of oxygen. Great feeders, strong of wing and stout of heart, with warm, fast-flowing blood and high temperature, they are, in every sense of the word, alive to their environment.

ROBIN-REDBREAST.

The robin and his world-wide congeners form the genus *Turdus*, or true thrushes, comprising upward of fifty well-defined species distributed throughout the forest regions of the globe, excepting Australia and New Zealand, where they are replaced by an allied group.

In the palæarctic region of the Old World four widely distributed species occur, all having spotted breasts in the adult plumage. The red-winged thrush breeds in the birch region, and throughout the upper belt of pines across Europe and Asia, from the Atlantic to the Pacific. He is rare east of the valley of the Yenisei, but extends his wanderings northward as far as

latitude 71° beyond the forest limit. The red-wing winters in southern and western Europe and the British Islands.

The blue-backed thrush, or "field-fare," has a range somewhat similar with the above species; Asiatic individuals migrating in winter to Cashmere, Turkistan, and the northwestern portion of India. The missel-thrush breeds throughout central Europe, ranging eastward to the northwestern slopes of the Himalayas. In such a mild climate as Great Britain offers, he remains the year round, but the majority of individuals winter in southern Europe, Persia, and North Africa. The song-thrush is another palæarctic form, breeding eastward to the Yenisei Valley, and in Norway wandering beyond the Arctic Circle. He has a near relative inhabiting northern and western China, known as Père David's thrush, in honor of a good monk who devoted much time to the study of ornithology.

SONG-THRUSH.

There are two spotted-breasted thrushes restricted each to a certain island, and found nowhere else: the Anjuan thrush, inhabiting one of the islands of the Comoro group, lying between Madagascar and the African coast; and the St. Thomas thrush, from the island of that name, in the Gulf of Guinea.

In the New World the nearctic, or North American region, possesses several species of spotted-breasted thrushes breeding throughout its forest area. Notable among these are the wood-thrush, whose mellow, rippling music we know and love so well; the hermit, the olive-backed, the gray-cheeked, and tawny thrushes—spring and fall migrants passing through our woods in May and October.

In contrast to the spotted-breasted species, there are a number of thrushes, and among them the robin, which are solidly colored underneath, a few spots being confined to the throat. This difference in color-pattern has undoubtedly arisen far back in the history of the group from some environing influence. The young of these solid-colored thrushes are all spotted like the rest, and, since the young of all animals tend to revert toward ancestral forms and conditions, the spotted-breasted species may be looked upon as representing the more primitive type of thrush. A further proof of this is found in the two spotted-breasted thrushes inhabiting the islands above men-

tioned, which from their isolated habitat are undoubtedly of considerable antiquity as species. Our robin is the only representative of the thrushes with solid-colored breasts found in North America, but a host of them occur in South America and some in Africa.

This contrast between the northern and southern continents of the New World, or, to speak zoölogically, between the nearctic and neotropical regions, in the number of species of thrush, has its solution in the peculiarity and variety of physical conditions offered by South America. The ranges of the species inhabiting the great forests of the equatorial zone are in the majority of instances restricted to comparatively limited areas. The varied conditions offered by high mountain-ranges and deep, low-lying forests, tend to the creation of new varieties or local races, which are consequently limited to certain narrow areas, and a particular species is often thus represented by several extreme forms. In temperate North America, on the other hand, the fewer species are kept true by migration, which tends to equalize surrounding conditions.

In northern South America, the valley of the Amazon, and the forests of Brazil, three distinct varieties of the white-throated thrush occur. The common South American thrush, a comparatively widely ranging species, reaching southward to Chili, has an extreme form in the northwest. The Sabian thrush is another species which has split up into several forms under the influence of local conditions. No region in the world is so rich in the number and variety of its passerine birds. In the south temperate portion of the continent the species of thrush are more uniform, and very few varieties are found.

WOOD-THRUSH.

Africa has several well-defined representatives of the solid-colored-breasted thrushes. The Zanzibar thrush and the Abyssinian thrush are eastern forms; in the west, the Ethiopian and Senegambian thrushes are found; while to the southward the olive-thrush, Cabani's thrush, and the Kurichane thrush range throughout the Transvaal, Caffraria and Damara Land, the Bechuana country, and the Cape.

The facts, as they are presented to-day by this interesting group of birds, become very significant when viewed in the light of evolution. The world-wide distribution, large number of

established species, and high degree of development which the thrushes have attained, denote their comparative antiquity as a group of birds. Time has been the important factor in establishing the species, and enabling them to live far and wide in harmony with diverse conditions of life. It would be difficult to ascertain the original center of their development—probably one of the great land-masses, as the Euro-Asiatic continent, whence the early forms have spread to other portions of the earth, there to break up into new varieties and species under the action of changing environments.

Where other forms have succumbed in the struggle for life these have lived on, until now, the almost perfect wing and foot; the vital strength that holds the plumage for a year before it is shed, and also enables the mating pair to rear three goodly broods each spring; the vocal development, the omnivorous diet, the abundance and world-wide distribution of species, tell the story of how the robin and his congeners have come to be what they are—a dominant group in the animal life of the earth.

THE RELATION OF EVOLUTION TO MATERIALISM.*

By Professor JOSEPH LE CONTE.

IT was seen in the sketch previously given † that, after every struggle between theology and science, there has been a readjustment of some beliefs, a giving up of some notions which really had nothing to do with religion in a proper sense, but which had become so *associated* with religious belief as to be confounded with the latter—a giving up of some line of defense which ought never to have been held, because not within the rightful domain of theology at all. Until the present the whole difficulty has been the result of misconception, and Christianity has emerged from every struggle only strengthened and purified, by casting off an obstructing shell which hindered its growth. But the present struggle seems to many an entirely different and far more serious matter. To many it seems no longer a struggle of theology, but of essential religion itself—a deadly life-and-death struggle between religion and materialism. To many, both skeptics and Christians, evolution seems to be synonymous with blank materialism, and therefore cuts up by the roots every form of religion by denying the existence of God and the fact of immortality. That the enemies of religion, if

* From "Evolution and its Relation to Religious Thought." By Professor Joseph Le Conte. New York: D. Appleton & Co., 1888.

† "Popular Science Monthly" for January, 1888.

there be any such, should assume and insist on this identity, and thus carry over the whole accumulated evidence of evolution as a demonstration of materialism, although wholly unwarranted, is not so surprising; but what shall we say of the incredible folly of her friends in admitting the same identity?

A little reflection will explain this. There can be no doubt that there is at present a strong and to many an overwhelming tendency toward materialism. The amazing achievements of modern science; the absorption of intellectual energy in the investigation of external Nature and the laws of matter have created a current in that direction so strong that of those who feel its influence—of those who do not stay at home, shut up in their creeds, but walk abroad in the light of modern thought—it sweeps away and bears on its bosom all but the strongest and most reflective minds. Materialism has thus become a fashion of thought; and, like all fashions, must be guarded against. This tendency has been created and is now guided by science. Just at this time it is strongest in the department of biology, and especially is evolution its stronghold. This theory is supposed by many to be simply demonstrative of materialism. Once it was the theory of gravitation which seemed demonstrative of materialism. The sustentation of the universe by law seemed to imply that Nature operates itself and needs no God. That time is past. Now it is evolution and creation by law. This will also pass. The theory seems to many the most materialistic of all scientific doctrine only because it is the *last* which is claimed by materialism, and the absurdity of the claim is not yet made clear to many.

The truth is, there is no such necessary connection between evolution and materialism as is imagined by some. There is no difference in this respect between evolution and any other law of Nature. In evolution, it is true, the last barrier is broken down, and the whole domain of Nature is now subject to law; but it is only *the last;* the march of science has been in the same direction all the time. In a word, evolution is not only not identical with materialism, but, to the deep thinker, it has not added a feather's weight to its probability or reasonableness. Evolution is one thing and materialism quite another. The one is an established law of Nature, the other an unwarranted and hasty inference from that law. Let no one imagine, as he is conducted by the materialistic scientist in the paths of evolution from the inorganic to the organic, from the organic to the animate, from the animate to the rational and moral, until he lands, as it seems to him, logically and inevitably, in universal materialism —let no such one imagine that he has walked all the way in the domain of science. He has stepped across the boundary into the

domain of philosophy. But, on account of the strong tendency to materialism and the skillful guidance of his leaders, there seems to be no such boundary; he does not distinguish between the inductions of science and the inferences of a shallow philosophy; the whole is accredited to science, and the final conclusion seems to carry with it all the certainty which belongs to scientific results. The fact that these materialistic conclusions are reached by some of the foremost scientists of the present day adds nothing to their probability. In a question of science, viz., the law of evolution, their authority is deservedly high, but in a question of philosophy, viz., materialism, it is far otherwise. If the pure scientists smile when theological philosophers, unacquainted with the methods of science, undertake to dogmatize on the subject of evolution, they must pardon the philosophers if they also smile when the pure scientists imagine that they can at once solve questions in philosophy which have agitated the human mind from the earliest times. I am anxious to show the absurdity of this materialistic conclusion, but I shall try to do so, not by any labored argument, but by a few simple illustrations:

1. It is curious to observe how, when the question is concerning Nature, we no sooner find out how a thing is made than we immediately exclaim, "It is not made at all—it became so of itself!" So long as we knew not how worlds were made, we of course concluded they must have been created; but, so soon as science showed *how* it was probably done, immediately we say we were mistaken—they were not made at all. So also, so long as we could not imagine how new organic forms originated, we were willing to believe they were created; but, so soon as we find that they originated by evolution, many at once say, "We were mistaken—no creator is necessary at all." Is this so when the question is concerning a work of man? Yes, of one kind—viz., the work of the magician. Here, indeed, we believe in him, and are delighted with his work, until we know how it is done, and then all our faith and wonder cease. But in any honest work it is not so; but, on the contrary, when we understand how it is done, stupid wonder is changed into intellectual delight. Does it not seem, then, that to most people God is a mere wonder-worker, a chief magician? But the mission of science is to show us how things are done. Is it any wonder, then, that to such persons science is constantly destroying their superstitious illusions? But if God is an honest worker, according to reason—i. e., according to law—ought not science rather to change gaping wonder into intelligent delight—superstition into rational worship?

2. Again, it is curious to observe how an *old truth*, if it come

only in a *new form*, often strikes us as something unheard of, and even as paradoxical and almost impossible. A little over thirty years ago a little philosophical toy, the gyroscope, was introduced and became very common. At first sight it seems to violate all mechanical laws and set at naught the law of gravitation itself. A heavy brass wheel, four to five inches in diameter, at the end of a horizontal axle, six or eight inches long, is set rotating rapidly, and then the free end of the axis is supported by a string or otherwise. The wheel remains suspended in the air while slowly gyrating. What mysterious force sustains the wheel when its only point of support is at the end of the axle, six or eight inches away? Scientific and popular literature were flooded with explanations of this seeming paradox. And yet it was nothing new. The boy's top, that spins and leans and will not fall, although solicited by gravity, so long as it spins, which we have seen all our lives without special wonder, is precisely the same thing.

Now, evolution is no new thing, but an old familiar truth; but, coming now in a new and questionable shape, lo, how it startles us out of our propriety! Origin of forms by evolution is going on everywhere about us, both in the inorganic and the organic world. In its more familiar forms it had never occurred to most of us that it was a scientific refutation of the existence of God, that it was a demonstration of materialism. But now it is pushed one step farther in the direction it has always been going—it is made to include also the origin of species—only a little change in its form, and lo, how we start! To the deep thinker, now and always, there is and has been the alternative—materialism or theism. God operates Nature or Nature operates itself; but evolution puts no new phase on this old question. For example, the origin of the individual by evolution. Everybody knows that every one of us individually became what we now are by a slow process of evolution from a microscopic spherule of protoplasm, and yet this did not interfere with the idea of God as our individual maker. Why, then, should the discovery that the species (or first individuals of each kind) originated by evolution destroy our belief in God as the creator of species?

3. It is curious and very interesting to observe the manner in which vexed questions are always finally settled, if settled at all. All vexed questions—i. e., questions which have tasked the powers of the greatest minds age after age—are such only because there is a real truth on both sides. Pure, unmixed error does not live to plague us long. Error, when it continues to live, does so by virtue of a germ of truth contained. Great questions, therefore, continue to be argued *pro* and *con* from age to age, because each side is in a sense—i. e., from its own point of view

—true, but wrong in excluding the other point of view; and a true solution, a true rational philosophy, will always be found in a view which combines and reconciles the two partial, mutually excluding views, showing in what they are true and in what they are false—explaining their differences by transcending them. This is so universal and far-reaching a principle that I am sure I will be pardoned for illustrating it in the homeliest and tritest fashion. I will do so by means of the shield with the diverse sides, giving the story and construing it, however, in my own way. There is, apparently, no limit to the amount of rich marrow of truth that may be extracted from these dry bones of popular proverbs and fables by patient turning and gnawing.

We all remember, then, the famous dispute concerning the shield, with its sides of different colors, which we shall here call white and black. We all remember how, after vain attempts to discover the truth by dispute, it was agreed to try the scientific method of investigation. We all remember the surprising result. Both parties to the dispute were right and both were wrong. Each was right from his point of view, but wrong in excluding the other point of view. Each was right in what he asserted, and each wrong in what he denied; and the complete truth was the combination of the partial truths and the elimination of the partial errors. But we must not make the mistake of supposing that truth consists in *compromise*. There is an old adage that truth lies in the middle between antagonistic extremes. But it seems to us that this is the place of *safety*, not of truth. This is the favorite adage, therefore, of the timid man, the time-server, the fence-man, not the truth-seeker. Suppose there had been on the occasion mentioned above one of these fence-philosophers. He would have said: "These disputants are equally intelligent and equally valiant. One side says the shield is white, the other that it is black; now truth lies in the middle; therefore, I conclude the shield is gray or neutral tint, or a sort of pepper-and-salt." Do we not see that he is the only man who has no truth in him? No; truth is no heterogeneous mixture of opposite extremes, but a stereoscopic combination of two surface views into one solid reality.

Now, the same is true of all vexed questions, and I have given this trite fable again only to apply it to the case in hand.

There are three possible views concerning the origin of organic forms whether individual or specific. Two of these are opposite and mutually excluding; the third combining and reconciling. For example, take the individual. There are three theories concerning the origin of the individual. The first is that of the pious child who thinks that he was made very much as he himself makes his dirt-pies; the second is that of the

street-gamin, or of Topsy, who says, "I was not made at all, I growed"; the third is that of most intelligent Christians—i. e., that we were made by a process of evolution. Observe that this latter combines and reconciles the other two, and is thus the more rational and philosophical. Now, there are also three exactly corresponding theories concerning the origin of species. The first is that of many pious persons and many intelligent clergymen, who say that species were made at once by the Divine hand *without natural process*. The second is that of the materialists, who say that species were not made at all, they were derived, "they growed." The third is that of the theistic evolutionists, who think that they were *created* by a process of evolution—who believe that making is not inconsistent with growing. The one asserts the Divine agency, but denies natural process; the second asserts the natural process, but denies Divine agency; the third asserts *Divine agency by natural process*. Of the first two, observe, both are right and both wrong; each view is right in what it asserts, and wrong in what it denies—each is right from its own point of view, but wrong in excluding the other point of view. The third is the only true rational solution, for it includes, combines, and reconciles the other two; showing wherein each is right and wherein wrong. It is the combination of the two partial truths, and the elimination of the partial errors. But let us not fail to do perfect justice. The first two views of origin, whether of the individual or of the species, are indeed both partly wrong as well as partly right; but the view of the pious child and of the Christian contains by far the more essential truth. Of the two sides of the shield, theirs is at least the whiter and more beautiful.

But, alas! the great bar to a speedy settlement of this question and the adoption of a rational philosophy is not in the head but in the heart—is not in the reason but in pride of opinion, self-conceit, dogmatism. The rarest of all gifts is a truly tolerant, rational spirit. In all our gettings let us strive to get this, for *it* alone is true wisdom. But we must not imagine that all the dogmatism is on one side, and that the theological. Many seem to think that theology has a "*pre-emptive right*" to dogmatism. If so, then modern materialistic science has "*jumped the claim.*" Dogmatism has its roots deep-bedded in the human heart. It showed itself first in the domain of theology, because there was the seat of power. In modern times it has gone over to the side of science, because here now is the place of power and fashion. There are *two dogmatisms*, both equally opposed to the true rational spirit, viz., the old theological and the new scientific. The old clings fondly to old things, only because they are old; the new grasps eagerly after new things, only because

they are new. True wisdom and true philosophy, on the contrary, try all things both old and new, and hold fast only to that which is good and true. The new dogmatism taunts the old for credulity and superstition; the old reproaches the new for levity and skepticism. But true wisdom perceives that they are both equally credulous and equally skeptical. The old is credulous of old ideas and skeptical of new; the new is skeptical of old ideas and credulous of new. Both deserve the unsparing rebuke of all right-minded men. The appropriate rebuke for the old dogmatism has been already put in the mouth of Job in the form of a bitter sneer: "No doubt ye are the people, and wisdom shall *die* with you." The appropriate rebuke for the new dogmatism, though not put into the mouth of any ancient prophet, ought to be uttered—I will undertake to utter it here. I would say to these modern materialists, "No doubt ye are the men, and wisdom and true philosophy were *born* with you."

Let it be observed that we are not here touching the general question of the personal agency of God in operating Nature. This we shall take up hereafter. All that we wish to insist on now is that the process and the law of evolution do not differ in their relation to materialism from all other processes and laws of Nature. If the sustentation of the universe by the law of gravitation does not disturb our belief in God as the sustainer of the universe, there is no reason why the origin of the universe by the law of evolution should disturb our faith in God as the creator of the universe. If the law of gravitation be regarded as the divine mode of sustentation, there is no reason why we should not regard the law of evolution as the divine process of creation. It is evident that if evolution be materialism, then is gravitation also materialism; then is every law of Nature and all science materialism. If there be any difference at all, it consists only in this: that, as already said, here is the *last* line of defense of the supporters of supernaturalism in the realm of Nature. But being the last line of defense—the last ditch—it is evident that a yielding here implies not a mere shifting of line, but a change of base; not a readjustment of details only, but a *reconstruction of Christian theology.* This, I believe, is indeed necessary. There can be little doubt in the mind of the thoughtful observer that we are even now on the eve of the greatest change in traditional views that has taken place since the birth of Christianity. But let no one be greatly disturbed thereby. For as then, so now, change comes not to destroy but to fulfill all our dearest hopes and aspirations; as then, so now, the germ of living truth has, in the course of ages, become so incrusted with meaningless traditions which stifle its growth, that it is necessary to break the shell to set it free; as then, so

now, it has become necessary to purge religious belief of dross in the form of trivialities and superstitions. This has ever been and ever will be the function of science. The essentials of religious faith it does not, it can not, touch, but it purifies and ennobles our conceptions of Deity, and thus elevates the whole plane of religious thought.

It will not, of course, be expected of me to give, even in briefest outline, a system of reconstructed Christian thought. Such an attempt would be wholly unbecoming. Time, very much time, and the co-operation of many minds, bringing contributions from many departments of thought, are necessary for this. In a word, it can only itself come by a gradual process of evolution. But from the point of view of science some very fundamental changes in traditional views are already plain. Of these the most fundamental and important are our ideas concerning God, Nature, and man in their relations to one another.

SOUND-SIGNALS AT SEA.

By ARNOLD BURGES JOHNSON.

THE difficulty in determining the true and exact direction of the sounds we hear meets us in various ways. The hunter hears the note of a bird, the hiss or whistle of a deer, and the sound indicates identity and proximity but not direction. The hunter waits for repeated renewal of the sound to ascertain its exact position, and even then verifies his audition by his vision. The hunter by his camp-fire may aim between the luminous dots of reflected light, which he knows to be the eyes of a wolf; but he would scarcely be able to aim at or even very near that spot on simply hearing the howl from the wolf that owns the eyes.

The plainsman hears a shout in the distance. He may recognize it as the voice of a comrade, and fix the general direction as north, east, south, or west, but hardly more. He may shout back, and the two may come together; but if it be dark and there is no fire or other signal, the shouting back and forth must be frequently repeated, and varied from a simple to a complex sound, that each may correct the error of his own audition, eliminate his personal equation, and the sound will appear to swing, pendulum-like, right and left, with shorter and shorter stroke, till the comrades come together.

The average child, returning from school, on entering the house calls, "Mamma!" The mother, perhaps, replies, "Yes!" "Where are you?" is the next question, and the reply informs the child not only as to the floor, but as to the room in which

the mother can be found. The child can not determine its mother's location by the sound of her voice. This exaggerated instance may be owing to the reflection of the sound, not only from the walls, but from the strata of air differing in temperature and humidity.

How many of us going to the next street, running at right angles to the car-tracks, can tell, from hearing the bell of the approaching street-car before the car comes in sight, whether that car is going north or south? It does not seem that animals can determine the direction of sound much better than man. The sleeping dog, roused by his master's call, is all abroad as to his master's location, and determines it by sight or scent, or both, frequently running in several different directions before hitting the right one. The deer, on being startled by the unseen hunter's tread, is not always right in his selection of the route to get out of harm's way. A flock of geese, ducks, or other birds, on hearing a gun, is as likely to fly toward as from the sportsman, if he has kept entirely out of sight, and the flash of his piece has not been seen.

It is a question whether the blind are better able to determine the direction of sound by ear than are seeing people. It is possible that their senses of touch and smell are so highly developed that their instantaneous action with that of the ear give them a decided advantage over seeing people in this matter. I have known a blind man to be so sensible of the current of air put in motion by the speaking of a single word in a room, that he could select the speaker by his location, though others were present. So, too, I have known a blind man to locate and identify the various people in the room, he saying he did it by the different scent evolved from each, the seeing people there not being sensible of any scent from any one. And yet he, when standing in the middle of the room with his nose stopped, could not give the direction of one single speaking person.

Prof. Alexander Graham Bell reports, in a paper he read before the American Association for the Advancement of Science at Saratoga in 1879, a series of experiments in binaural audition, showing, among other things, that direction can not be appreciated by monaural observation; that when the source of sound is at the nadir of the observer, the perception of its direction is absolutely unreliable, and that not one of the many on whom he tried the experiment had the slightest idea of the true direction of a sound produced beneath him.

We are so much accustomed to the aid of our other senses, especially that of sight, that we incline to give more value to audition in determining direction than it deserves. That is one reason why we err so largely when so placed that the eye can

not correct the error of the ear—in fact, many people seem to be unaware that they have any inability to locate sound by the ear until they have learned the fact by experience, and even then they appear to consider marked instances as abnormal.

It is sufficiently easy to account for aberrations of audition as to the direction of sound from objective causes, such as reflection, diffraction, and deflection of sound-waves. But it may also often be accounted for by what Prof. Henry called subjective causes, such as induce belief that an anticipated sound has come from a specified direction, when it has really come from quite another direction. Here the personal equation of the listener must be largely taken into consideration. The success of the ventriloquist may also depend upon subjective causes.

President Welling tells us something of how Prof. Henry, when at Princeton, induced subjective causes in his pupils, to their bewilderment, making them believe, for the moment, that a given sound came from a specified corner of the class-room, when it really came from quite a different direction.

Mariners are beginning to accept the fact that they may err in assigning the true direction to sound; but their ideas on the subject are still vague and indeterminate. Hence occur collisions between ships at sea, and lawsuits between their owners on shore. The collision at 10 P. M., on September 21, 1882, between the Dutch steamer Edam and the British steamer Lepanto, on George's Bank, Atlantic Ocean, when the former was sunk by the latter, resulted in a suit in the United States District Court at New York city, in which the case turned on an erroneous location of the Edam by the Lepanto, on hearing the sound of her fog-horn. The court dismissed the case with costs, holding that "an error of five points in locating a vessel's position by the sound of her whistle in a fog is not necessarily a fault under the proved aberrations in the course of sound." The judge, in his decision, quotes, among others, papers read before the Washington Philosophical Society as his authority for certain statements he makes as to these laws of sound bearing on the case.*

As it seems evident that the unassisted ear is likely to err in determining the location of sound, the question arises, Can the ear be aided in this matter? Apparently this is possible. Prof. Mayer, of the Institute of Technology at Hoboken, N. J., has, to a certain extent, solved this problem by the construction of an instrument called the "topophone," by the use of which President Morton, a member of the Lighthouse Board, was enabled to locate within ten degrees, or less than one compass-point, the sound of a fog-signal, when in the cabin of a steamer

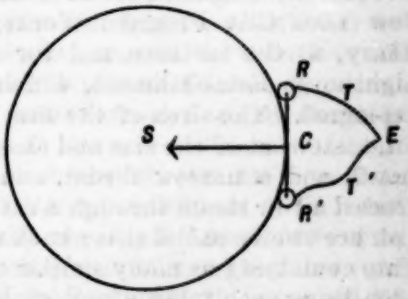
* See "Federal Reporter," October 28, 1884, p. 651.

at sea, seven miles away, and that, too, after he had purposely deprived himself of a knowledge of even the direction of the shore by having the steamer turned in her course from time to time. President Morton describes it thus:

This apparatus consisted of the following parts: A vertical rod passing through the roof of the deck-cabin, on the upper end of which was attached a horizontal bar carrying two adjustable resonators. Below these was a pointer set at right angles with the above bar. Rubber tubes passed through the roof of the cabin and were connected with a pair of ear-tubes. A handle attached to the vertical rod served to turn it in any direction.

The principle upon which the operation of this apparatus depends was first announced by Prof. Mayer in 1872 (see "American Journal of Science and Art," November, 1872, p. 387), and its general operation may be explained as follows:

Let S of the diagram be the source of a sound, and let the circle represent a wave-surface produced by that sound. On this surface all the molecules of air have, at the same instant, the same direction and the same velocity of vibratory motion. If we can accurately determine two points, R and R′, on this wave-surface, and this wave-surface be a spherical one, that is, be not deformed, then a perpendicular, C S, erected to the center of a chord drawn between these two points, will, when produced, pass through the source, S. The method consists in determining these two points on a sonorous wave-surface, as follows:



Let R and R′ be two resonators accurately tuned to the note given by the vibratory body at S. Suppose both resonators at the same instant on the wave-surface, then they both receive, at the same instant, the same phase of vibration, on the planes of their mouths. If two tubes of equal length lead from the resonators and join into one tube just before they reach the ear, E, then the sound-pulses will act together, being of the same phase, and the ear will receive double the action which it would if only one resonator were connected with the ear. But suppose that one of these tubes, T′, differs in length from the other tube, T, by one half of a wave-length of the tone given out by S, then the same pulses will no longer work together at E, but will be opposed to each other in their action, neutralizing each other's dynamic effect, and producing silence at the ear, E. This last condition is the one used in the apparatus above described.

We connect the two resonators, R and R′, by a rigid rod, and it is evident, if a pointer be placed at the center of this rod at right angles to its length, that when the resonators, R and R′, are on the wave-surface, the rod, C S, will point toward the source of sound at S. The rigid rod connecting the resonators, R and R′, turns on a vertical rod passing through C. This arrangement was described by Prof. Mayer before the National Academy in April, 1876.

While this contrivance may not yet be entirely practicable, its use, as detailed, makes the fact evident that some apparatus

can be arranged by which the aberration in the audition of the mariner may be so corrected that he can locate the source of the sound which is made to assure his safety, but which, misheard, may, as in the case of the Edam and Lepanto, insure his destruction.

It seems evident from President Morton's statements that if the fog-signals of the maritime world, or even of one country, or even those located in the approaches to one of our great harbors, were tuned to one note, and if the ships frequenting those waters were fitted with topophones, or some similar instrument, arranged so as to be in unison with the fog-signals, that aberrations in audition, at least as to direction, might be corrected, so as to determine the location of sound to within at least one compass-point.

Since the development of the topophone a number of other instruments have been invented for determining for the mariner the direction of sound made to warn him from danger. For some time some of our best ocean-steamers have been supplied with an instrument giving sounds of wonderful pitch and intensity, called the siren. It was adapted from the instrument invented by Cagniard de la Tour, by A. and F. Brown, of the New York City Progress Works, under the guidance of Prof. Henry, at the instance and for the use of the United States Lighthouse Establishment, which also adopted it for use as a fog-signal. The siren of the first class consists of a huge trumpet, somewhat of the size and shape used by Daboll, with a wide mouth and a narrow throat, and is sounded by driving compressed air or steam through a disk placed in its throat. In this disk are twelve radial slits; back of the fixed disk is a revolving plate containing as many similar openings. The plate is rotated 2,400 times each minute, and each revolution causes the escape and interruption of twelve jets of air or steam through the openings in the disk and rotating plate. In this way 28,800 vibrations are given during each minute that the machine is operated; and, as the vibrations are taken up by the trumpet, an intense beam of sound is projected from it. The siren is operated under a pressure of seventy-two pounds of steam, and can be heard, under favorable circumstances, from twenty to thirty miles. "Its density, quality, pitch, and penetration render it dominant over such other noises after all other signal-sounds have succumbed." It is made of various sizes or classes, the number of slits in its throat-disk diminishing with its size. This instrument is now used as a fog-signal by most maritime nations, they having frankly copied from, and, in some instances, obtained it through the United States Lighthouse Establishment; and it has been recently adapted to the use of

ocean-steamers. But, to make it thoroughly useful, M. Edme Genglaire, a student of the Naval School of Medicine at Toulon, has combined with the siren what purports to be the leading idea of the topophone by fixing an invariable standard for comparison. The siren being in communication with the boiler, the current of steam can be governed by an ordinary valve. The sounds produced vary in pitch and intensity in proportion to the quantity of steam emitted, so that sounds of any given pitch can be obtained. A set of resonators completes the apparatus.

It is well known that two identical resonators vibrate together for the same sound and for that only. Starting with this principle, in two similar frames containing several resonators, the corresponding resonators will vibrate or sound only when the note corresponding to them is produced. The siren will produce these sounds causing vibrations in the resonators, and two distant ships, or a shore-station and a ship, or two land-stations, supplied with sirens of a similar model and identical frames of resonators, could most conveniently communicate. For this end each resonator should have attached to it an invariable signification, the same for all the frames.

All the naval and commercial vessels possessing sirens and a frame carrying the same number of resonators, each marked with a number having its signification, might be prepared to communicate with each other or with the shore.

This is the practical way of carrying the theory out as proposed by M. Genglaire:

In front of each resonator will be placed two metallic reeds, one rigid, the other thin and producing extended oscillations with the least effort. Each of these pieces of steel communicates with one pole or battery by means of the circuit wire. When the resonator vibrates, the thin reed oscillates, touches the other bar, and the two poles of the battery being connected, an electric bell rings, thus giving a signal, so that the call, whether from ship or shore, can be recognized, while the bell of the signaling-station, by its sounds, shows that the desired vibration or note has been produced. This account of Genglaire's siren is condensed from the account published in "Électricité."

Colladon made a series of experiments* at Lake Geneva in 1826 to determine the velocity of sound in water. He had a bell weighing about one hundred and fifty pounds suspended some five feet under water from the side of a boat, and struck by a hammer attached to the end of a lever. Stationed in another boat he listened for the bell-sounds, propagated beneath the sur-

* "Memoirs of the Institute of France," vol. v, 1838, pp. 329–399; Sir John Herschel, "Sound," sections 94, 95; "Journal of Science," vol. i, 1828, pp. 480, 481; "Edinburgh New Philosophical Journal," vol. v, 1828, pp. 91–94.

face, which were conveyed from the water by a cylindrical tube of tin some nine feet long and six inches in diameter, one end of which terminated in an orifice for insertion in the ear, and the other was spread out somewhat in the form of a spoon, its opening being closed by a flat, elliptic plate of tin, about two square feet in area. By attaching a suitable weight to the lower end of the tube it was easily retained in a vertical position with about four fifths of its length submerged, its flat plate being turned toward the boat carrying the bell. With this simple apparatus, Colladon was able to hear with perfect distinctness the blows of the hammer on the bell across the widest part of Lake Geneva, when the calculated distance between the two boats was not less than eight miles.

The sounds heard by Colladon appeared as if they had been caused "by some metallic body striking the bottom of the tube," and they were "as distinct and brief at 13,000 metres as at 100 metres from the bell." One set of observations were made during a strong wind: "The lake, which was at first calm, became violently agitated, and it was necessary to keep the boat in position by means of several anchors; yet, in spite of the noise of the waves which struck the tube, he took other observations with the same accuracy as when the air and water were still. And he states, "I am convinced that by employing a bigger bell, and improving or enlarging the hearing apparatus, easy communication could be effected under the water of a lake or of the sea up to fifteen or twenty leagues."

In February, 1883, Prof. Lucien I. Blake,* now of the University of Kansas, but then in Berlin, while investigating the experiments of Colladon and also of Sturm, as to the velocity of sound through the waters of Lake Geneva, thought of making a practical use of water as a means of communication between vessels at sea. He then devised several methods, assisted by Dr. König, of the Physical Laboratory at the Royal University, which he tried on his return to this country, and he has been experimenting in that direction from time to time since that date, as opportunity served.

His plan, in brief, was as follows: A sound-producing apparatus was to be attached to each vessel, and to be worked under the surface of the water. In times of fog or at night a code of signals would be produced by it which would be transmitted in all directions through the water, with a velocity four to five times that in the air. Each vessel, in addition to the sound-producing apparatus, would be provided with a sound-receiving apparatus,

* Prof. Blake read a paper on this subject before the American Association for the Advancement of Science, at the meeting in New York, in August, 1887, from which, with his kind permission, this abstract has been made.

which would take up out of the water the signals arriving from neighboring vessels. As boys in swimming communicate the sound of the striking of stones together under water, so is it possible to send musical tones from one ship to another.

For steamships the sound-producing apparatus was designed to be a steam fog-horn or whistle, specially constructed to sound under water, and to be heard at least from six to eight miles. From the nature of its tone it would be easily distinguishable from other sounds always more or less present under water, such as from breakers, waves, etc. With such whistles a Morse alphabet of long and short blasts and pauses was to provide a means of extended communication, while a simple universal code would indicate a ship's course. Since ignorance of the very presence of a ship, rather than incorrect estimates of her course, has been the principal cause of ocean collisions, the simple hearing of the sound would prove a most excellent general safeguard. Bell-buoys were to have a second bell added under water, while lightships, lighthouses, and any headlands might also be provided with submerged bells which could be rung from the shore, when necessary. Sailing-craft, both large and small, would have bells; and, since an ordinary locomotive-bell can be heard, according to experiments, at least two miles under water, these simple means would seem to afford sufficient limits for protection for such vessels.

As to the receiving apparatus, with which each vessel was to be provided: The original plan of 1883, and which has not been changed, was to employ some form of telephone acting as a transmitter under water, and connected with a receiver within the vessel. The surface of the transmitter exposed to the water, and which must receive the sound-waves, should be protected against ice, barnacles, heavy waves, etc. One design was: One or more vertical pipes in different parts of a ship were to extend from the vessel's interior through the hull, near the keel, and be open to the free admission of water at their lower ends; their upper ends were to extend within the vessel a little way above the keel, and were to be plugged, so that the water could not overflow into the vessel. These pipes would then provide columns of water always still, and would communicate directly with the water outside. Sound would then enter and pass up these pipes, and would encounter microphonic transmitters placed suitably in them. Wires from the transmitters would run to a small room secluded where convenient in the ship, away from disturbing noises, and here telephone receivers would be placed, and observers stationed here in night or fog.

For small craft, it was found that a pipe shaped much like a powder-horn, with a thin, flexible membrane stretched tightly

across its broad end, made a successful receiver. With the small end made to fit the ear, and the diaphragm end only a few inches below the water, the sound of a hand-bell has been received nearly a mile distant. Colladon and Sturm used a somewhat similar receiver, and heard a heavy bell ten miles away.

It was necessary to devise a better form of receiving apparatus. The Bell receiver and the Blake transmitter will not work under water. The first success was obtained by a form of transmitter resembling the Ader.

With this Prof. Blake transmitted and received signals between boats half a mile apart on the Taunton River in 1883. The transmitter was weighted to float at different depths, but in all positions as regards the approaching sound-waves it received equally well. Up to half a mile the signals from an ordinary dinner-bell were distinctly heard. These experiments seemed to indicate that a transmitter dependent upon a variable contact might yet be made which would work with satisfaction. This line was consequently followed up, and apparatus was devised by which signals were transmitted between boats a mile distant off Stone Bridge, near Newport, R. I., in the same summer of 1883 through a rough sea and in a dense fog. Various forms of microphonic transmitters were constructed, and experiments on Long Island Sound and on the Wabash River at Terre Haute, Ind., were conducted as opportunity permitted. One form of transmitter which worked fairly well consists merely of a diaphragm having within itself the elements of a microphone. It is placed in simple voltaic circuit with a Bell receiver. This diaphragm is made of hard carbon in granules about the size of smallest shot. A paste is made of these with rubber cement, and this in a mold and die under heat and pressure becomes a hard, thin, elastic disk. This diaphragm takes up the sound-vibrations quite well out of the water. The action is similar to that of a multiple contact transmitter. On the river, however, through a long distance these did not seem sufficiently satisfactory. This difference in action between a long and short distance led to the thought that, as the advancing front of the sound-wave is an arc, approaching in curvature nearer and nearer the tangent to its circle, a large diaphragm would receive more sonorous energy and thus probably prove more effective. This is the point to which the experiments have now been carried, and the next trials will be with a diaphragm eighteen inches square. In October, 1885, signals were transmitted and received one and a half mile on the Wabash River from a locomotive-bell around three or four windings of the river, so that the operators were out of each other's sight and the sound

could not be heard through the air, yet could be with fair distinctness through the telephone.

It is to be hoped that Prof. Blake may find opportunity to continue his experiments, as he seems to be on the verge of producing a practical and accurate instrument of value to mariners.

Methods of using the Morse code of dots and dashes, as represented by long and short sounds of a fog-whistle or other similar contrivance, have been made public. The best one I have met is that of Mr. Frank Purinton, of Providence, R. I., and it is one of the best because it is the simplest. The idea is that, when two ships meet in fog and make known their proximity to each other by their fog-signals, each shall indicate to the other the way she is steering by the length and the intermission of the sounds made by her fog-signal. The following is the code in part, the long blast being represented by the [—] dash, the short one by the [-] dot:

Code.

North	—	One dash.
Northeast	— — —	Three dashes.
East	— —	Two dashes.
Southeast	- — —	One dot and two dashes.
South	-	One dot.
Southwest	- - -	Three dots.
West	- -	Two dots.
Northwest	— - -	One dash and two dots.

The thirty-two points of the compass are represented by variations of the collocations of dots and dashes on the chart, and with long and short sounds with intervals, in practice. These signals can be given by the ordinary steam-whistle or by automatic apparatus already invented and in use. Mr. Purinton claims that his system will, if followed, prevent collisions. The four cardinal points of the compass are so represented that opposite courses have opposite signals. One long sound means north; a short one, south. Two long sounds mean east, and two short ones mean west. Other points of the compass are indicated by the synthesis or natural combination made by adding the necessary cardinal signals for the intermediate points or courses.

Another device, which may be called the echo-maker, that of Mr. De la Torre, has been examined by a board of naval officers, of which Commander Bainbridge Hoff, United States Navy, was the head, and report was made to the Navy Department of a somewhat favorable nature. It may consist of a flaring funnel screwed on the muzzle of a rifle. It is operated by firing the rifle in the direction of the supposed obstacle, such as a rock, an iceberg, another ship, or a cliff. If the obstacle is there, the

beam of sound projected through the funnel strikes the obstacle and rebounds; and as the echo is more or less perfect in proportion as the obstacle is more or less parallel to the ship from which the gun is fired, and as it is near or remote, the position of the obstacle may thus be inferred. The board reported that De la Torre's method was firing a blank cartridge from a rifle in the presence of objects as small as a spar-buoy and as large as a fort, and catching the return sound or echo. He claims that a sharp sound projected at or nearly at an object, and only when so directed, will in every case return some of the sound sent, so that theoretically there will always be an echo, and the difference in the time between the sound sent and the echo will indicate the remoteness of the object. The board found that a return-sound could be heard from the side of a fort a half-mile off, from passing steamers a quarter-mile off if broadside-to, from bluffs and sails of vessels about the same distance, and from spar-buoys two hundred yards away.

The board further states that the sound from the different kinds of masses is different in most cases, and that the ear could be educated to detect quite a range of different objects, as the echo from a sail was different from the echo from a buoy or a bluff. If two objects were near the line of projection at different distances, an echo would be received from each. The horizontal limit of the return of sound seemed to be about two points on each side of the axis of projection.

If Mr. De la Torre should see fit to construct his instrument for hearing feeble echoes, the board indicated that it would recommend that it be fitted soon to some vessel of the North Atlantic Station, and that further and, if possible, exhaustive experiments ought to be made to practically determine the use of the echo as a means to discover obstacles to navigation. It was also stated that steam-whistles could be heard much farther than the echo; but it was said that where the obstacle could not make the sound, as in the case of an iceberg, the echo would be of the greatest use, and experiments looking to its utilization are demanded by the conditions of navigation in time of fog.

Steamers are constantly running among the islands on the coast of Maine during the summer. This is the season of thick and persistent fog. When pilots can hardly see the length of their vessels, they keep up a constant noise with their fog-signals. The open sea gives back no sound. But the near or remote vicinity of cliffs, bluffs, or even high shores, is indicated by the strength of the echo received back from them. In fact, running by echo is recognized as one of the necessities of the navigation of those waters.

This method is also used to some extent by steamers on the great rivers. And it is practiced on the Great Lakes to some extent, notably at a certain bluff jutting out into Lake Superior. Passing steamers, knowing themselves to be in the vicinity, when befogged, feel out these bluffs by sounding their fog-signals until they get back an echo; then they use the bluffs as a new point of departure.

In this connection I may say that in the summer of 1886 I experimented in making echoes while on a lighthouse steamer on Long Island Sound, and found I could get a good echo by sounding the whistle of my steamer when passing a sailing-vessel, preferably a schooner, on a parallel course. Wave-sounds striking her sails at right angles to her course, gave a good echo at five hundred yards or less, and the sound of the echo was more or less good within that distance, in proportion to the angle made by the courses of the two vessels when their courses were not parallel. When off Block Island cliffs, which overhang somewhat, I got a good echo when about a mile distant. Hence I infer that the position of suspected dangers of certain kinds can be determined by the production of echoes under specified circumstances.

Recent papers state that Mr. H. B. Cox, an electrician whose laboratory is at Fernbank, some ten miles from Cincinnati, has invented a trumpet to be used for telephoning at sea, on which he has been at work for some months. The invention is the outgrowth of his discovery of the great distance an echoed or reverberated sound will carry, and the discovery that speaking-trumpets, if made to give the same fundamental note, would vibrate and produce the phenomenon known in acoustics as "sympathy."

With this trumpet conversation in an ordinary tone of voice was carried on between parties four and a quarter miles apart. People a mile away, conversing in an ordinary tone, could be distinctly heard, and in two instances they were told the nature of their conversation, and admitted that such had taken place. The whistle of a train was traced beyond Fernbank to Lawrenceburg, Ind. It was found that the instrument has a well-defined range of twenty-six miles; that is, a loud sound like a locomotive-whistle, or the rumbling of a train, can be distinctly heard at a distance of thirteen miles in every direction. Conversation was readily carried on between two gentlemen on high hills on opposite sides of the Ohio River distant about four and a half miles apart. Tests made on the water, of various kinds, showed that the trumpet was even more available than on land.

It is generally understood that Mr. Edison, who has invented so many good things, is now at work, and has made promising

progress on the production of what may be called a water-telephone, by which he proposes to enable ships within hearing distance to communicate without wires, but still by electricity, sent and received through the water. He is said to have signaled through a mile of the Caloosahatchie River, in Florida, during his experiments made last winter.

The object of this paper is to call attention to the practical impossibility of the mariner determining, by his unassisted ears, in a fog or in darkness, the position of another ship from the noise she makes, and the necessity that he should use some of the appliances named, or better ones as they appear, to assist his ears, and thus to prevent the collisions which are now so frequent and so disastrous. The Celtic and Britannic steamers would not have run into each other had such appliances been used; nor would the steamer the City of Brussels have been run down in the English Channel by the steamer Kirby Hall had they been thus supplied, to say nothing of the steamer Oregon recently sunk off Fire Island, and other like cases within easy recollection. These vessels carried no such appliances.

It is desirable that public opinion should be brought to bear on this subject with such force that ships shall be *required* to carry some appliance, so that an error of five points in fixing a ship's position will no longer be possible, or, if possible, will be held to be criminal negligence.

It is also desirable that public opinion should be brought to bear on this subject with so much force that ships will be required to carry and use proper appliances for ascertaining the position and course of ships within ear-shot, as they are now required to carry lights for a like purpose.

And why should not the Federal Government take some steps in this direction, that the dread all now feel of collision at sea, in the fog or the darkness, may in some measure be eliminated?

Since the foregoing was in the hands of the editors, Senator Frye introduced into the Senate Bill No. 1851, "to provide for an international conference for securing greater safety for life and property at sea." The President, under this bill, is to invite each maritime nation to send delegates to a maritime conference, to meet at Washington in October next, and to appoint five delegates to represent the United States.

One of the duties prescribed for this conference is "to adopt a uniform system of marine signals or other means of plainly indicating the direction in which vessels are moving in fog, mist, falling snow, and thick weather, and at night."

This bill was referred to the Committee on Foreign Relations,

whence it was reported back on February 15th with certain helpful amendments. On February 23d it was taken up, when Senator Frye said: "That is a public bill of very great importance. . . . It is a bill recommended by the President and Secretary of State, and indorsed by nearly all the boards of trade, chambers of commerce, and maritime associations." The bill was then passed and sent to the House of Representatives, when it was referred to its Committee on Foreign Affairs.

PRIMITIVE WORSHIP OF ATMOSPHERIC PHENOMENA.

By the Count GOBLET D'ALVIELLA.

ATMOSPHERICAL manifestations, or the aggregate of the phenomena whose theatre is the atmosphere, present a mysterious appearance to primitive man, which, whether it seem beneficent or fearful, is always of a nature vividly to impress the imagination. Hence man very early regarded these phenomena as individualities endowed with body and soul, or as superhuman personalities, which he was afterward led to make an object of worship. This is easily shown to be the fact in the case of the dawn and twilight, wind, rain, clouds, whirlwinds, and waterspouts, lightning and thunder, echoes, the rainbow, the aurora borealis, the mirage, etc. Rain has at times been represented as honey or seed which fell from the sky to fertilize the earth, as in the myth of Danae; the peoples of India have personified the waters of the sky as the milkings of cows; a step further, and we have the goddess of rain. The Khonds of central India fabled that these waters were poured upon the earth through a sieve by a nymph who was called Pizou Pennou.

The clouds have been personified under the form of serpents, dragons, birds, or wolves; in the mythology of peoples who suffer from drought these personifications take the shape of thieves and receivers, which carry off the waters and keep them captive. Such assimilations may appear strange at first sight; it is hard for us to imagine that man could have compared the clouds to such objects. The philological school supposes that man began by giving the clouds the names of animals whose forms they most frequently affected; but at last these appellations lost their character, which was in its origin simply metaphorical, and thus arose the idea of assimilating the clouds to the animals whose names they bore. This theory is not without some foundation, but it is not in general indispensable to look to changes in language. Man, especially childish, primitive man, is

naturally disposed to substitute a relation of identity for a simple relation of analogy. On this subject M. de Gubernatis relates, in his "Zoologie mythologique," a personal recollection of the most significant character. When he was four years old, his brother having called his attention to a curious-looking group of clouds by saying, "See that wolf chasing the sheep!" he was so fully convinced that the cloud was really a hungry wolf running over the mountains, that he ran into the house, for fear that the wolf, not finding sheep, would take him.

Dawn and twilight are only rarely made divinities among untutored peoples. But they are personified in a curious Esthonian myth among the Finns. It is related in this story that the sun is a torch lit up every morning by *Koi*, the dawn, and put out every evening by *Œmmerik*, the twilight. Their father, *Ukko*, the sky, desiring to unite them, they consented to come together for a few days every year at the time of the summer solstice, at which time there is in Finland no night between the twilight and the dawn. On these days, the legend continues, Œmmerik passed the torch directly to his affianced, and she blew it alive with her breath before it had time to go out.

While both the twilight and the dawn were deified among the Aryans, the more special importance was given to Aurora, the dawn. She it was among the Greeks who daily with her rosy fingers opened the eastern gates, and brought back the light, which was equivalent to a new creation and the dispersion of the demons of night. In the Greek mythology, Aurora precedes the chariot of the sun; and on an Apuleian cup the decorator has depicted an ingenious allegory, showing Selene (the moon) mounted upon a chariot, and driving away, with her face veiled; Aurora preceding the solar team as it courses through the air; while around the chariot infants, representing the stars, are disappearing in the depths of the sky. This representation is very like a description that may be found in the Vedas, where it is sung: "The stars fly like thieves, in company with the night, before the radiance of the dawn, which, like a herald, precedes the course of the sun." "Hail, ruddy Ushas," says another hymn, "golden goddess, borne on thy bright chariot! Thou advancest like a solitary virgin, discovering to our admiring eyes all thy hidden graces, or like a spouse unveiling to her lord beauties which appear to him every morning more fresh and brilliant! Although thou countest years upon years, thou art always young. Thou art the breath and the life of all that lives and breathes, wakening every day myriads of prostrate sleepers, causing birds to fly out of their nests, and guiding the busy steps of mortals in the occupations which they pursue in the search for riches, pleasure, or fame." The Vedic *Ushas*, like the *Eos*

sung by the poets of Greece, are deities conceived as under a human form, but still imperfectly isolated from the phenomena which they personify. If, as Max Müller thinks, *Aditi*, of the Vedic mythology, is likewise a name for the dawn, we see clearly that the worship is addressed at first to the personified phenomenon, or to the spirit of the dawn conceived as inseparable from the phenomenon itself. A passage in the Vedas calls the dawn the face of Aditi. Moreover, if Pallas Athene was also the dawn with the Greeks, does not the fact that she was born issuing from the brain of Zeus—that is, of the sky—indicate that the worship was originally addressed to the personification, even before it was carried over to the goddess regent, of the phenomenon?

Wind and thunder have also been personified, or made objects in which was seen the action of a personal being having a sensible form appropriate to its office. To the savage the wind is produced by a blowing being, thunder by a thundering being. The Lapps imagine a living existence, who soars in the air, carefully listening to the words of men, and always ready to strike down any one whom he condemns. The Bushmen believe that the wind is a person. One of them met him one day in the country of the Boers, and threw a stone at him, when the wind fled to the mountain. In the "Iliad" Homer represents the winds as seated at the table of Zephyr, when Iris solicits their intervention to kindle the flames on the funeral pyre of Patroclus. In our own times, even in Europe, according to Mr. Tylor, the Carinthian peasant places on a tree in front of his house various foods to appease the hunger of the wind. In the Palatinate, when a storm is raging furiously, the peasant throws a handful of meal in the direction opposite to the wind, and calls out: "Stop, wind, here is food for your child; go away!" In South America, the Payaguas, when the wind shakes their huts, rush against the storm, waving fire-brands; while other tribes, under like circumstances, offer it tobacco. The forms given to the personification of the wind are extremely various. In Central America, it is often a bird; on the Congo, a horse; the American Indians make it a hare; the Botocudos represent it by a dog with clipped ears; the Germans gave it the figure of coursing dogs; and the Greeks represented it by cherubim's heads with swelled cheeks.

The idea of a distinction between the manifestations of the wind and thunder, and the being which produces or controls them, seems to have been gradually developed. The Dakotas attribute thunder to a great bird and its progeny. The male produces the isolated claps by the beating of its wings, and the reverberations are due to the beatings of the wings of the younger ones. To the Navajos, the winds are produced by four swans,

which, placed at the four points of the compass, beat their wings in alternation. The Assiniboins have a supreme deity, the manitou-bird, who lives in the upper skies; his eyes shoot out lightning, the beatings of his wings produce thunder, and his beak causes the falling rain. Belief in a thunder-bird is also found among the Brazilians, the Hervey-Islanders, the Caffres, and the Karens of Burmah. Thor, who strikes men with his hammer, is well known. In the Vedas, Parjana is depicted as the god with resounding song who beats down the forests and makes the earth tremble; who frightens the innocent, while he strikes down the guilty; who diffuses life, and at whose approach vegetation springs up again. The Yorubas of western Africa fancy that thunder is produced by the god Zaconta throwing stones. The Slavs attribute the noise of thunder to the rolling of Elijah's chariot in the skies. The legend of the celestial father playing at ninepins with the porter of paradise is of common lore. The classical Æolus is matched by a similar conception among the Iroquois and the Polynesians, by whom the winds are supposed to be controlled by a divinity who holds them shut up in a cavern, whence he lets them out at his will. A legend current in New Zealand has it that each wind is assigned to its cavern, where the god Maui lets them out, or shuts them up by rolling a great stone in front of the mouth. But the west wind is excepted from this rule; the god can not reach it or find its cave, and it therefore blows during the largest part of the year. The red Indians all believed in the spirit of the wind as the supreme god, or the Great Spirit. In the Vedas, we find in turn *Vâya*, the breath, *Vâta*, the breather, and *Roudra*, the howler. The Esthonians direct their prayers to the mother of the winds, and exclaim on the approach of a tempest: "The mother of the winds is groaning; who knows how many other mothers are going to groan in their turn?" Sometimes the god of the wind becomes a mythological personage so distinct that we find it hard to discover his natural character; and it is still under discussion whether Hermes or Mercury personified the wind or the twilight.

Whirlwinds or water-spouts have been personified under the form of giants, of gigantic serpents, and of sea-dragons, as they said in the middle ages. "The sea was troubled before them," relates a character in the "Thousand and One Nights"; "from its bosom rose a black column toward the sky; I looked, and it was a Jinn of gigantic stature." This belief is common with all the Mussulman peoples. The columns of sand in the desert pass, in the eyes of the Arabs, for wicked genii. In China they believe that these formations are dragons; the Zulus make great serpents of them.

It is hard to conceive in temperate latitudes of the splendor of

the light-pictures formed by the aurora borealis of the polar countries; and it is not surprising that the Greenlanders see in them a dance of spirits. Even in countries farther south, where the intensity of the phenomenon is greatly reduced, the aurora borealis has given rise to the most fantastic legends. An English writer of the sixteenth century represented the phenomenon as an "aggregation of brilliant arches whence issue fortified cities, swords, and warriors in order of battle; then jets of radiations in every direction, clouds and combats, in which the victors pursue the vanquished, while others fly around in a surprising fashion."

Echo passes nearly everywhere as the voice of a superhuman power. Lander relates that on the Niger his boatmen offered libations to an echo. When the traveler asked them the reason for it, they answered: "Do you not hear the fetich?" It is also conceivable that the existence of a voice should cause a belief in some one who speaks. The fact that this mysterious voice limits itself to repeating the words that are sent to it, has induced the fancy that the spirit has particular reasons for acting in this way, and it is in support of such reasons that myths, like that of Echo and others, have been given form.

The rainbow is one of the atmospheric phenomena that have been most generally personified. Peoples of almost every part of the world have made of it a living and terrible monster whose most venial offense is that of drinking up the waters of springs and ponds. This belief is found among the Burmese, Zulus, Indians of Washington Territory, ancient Mexicans, and Finns, and exists among the popular fancies of the Slavs and Germans, and some of the French populations. The Zulus and the Karens of Burmah imagine that the rainbow spreads sickness and death. The Karens, when they see one, say to their children: "The rainbow has come down to drink; do not play, for fear that harm may come to you!" Very singularly, too, the street boys in Volhynia run away, crying, "Run, it will drink you up!" In Dahomey, the rainbow is regarded as a heavenly serpent, *Danh*, which insures happiness. The modern Greeks hold it to be a beneficent but just and severe hero; they say that any one who jumps over a rainbow will change sex at once; but this saying, which is also current in Alsace, is only a picturesque way of indicating the impossibility of transforming a man into a woman, or a woman into a man. The Delians offered cakes to the rainbow, and the Peruvians put its image on the walls of their temples. The Caribs considered its appearance on the sea a favorable presage; but on the earth its influence was pernicious, and they hid from its view. It was personified by a viper.

A considerable number of peoples give the personified a coex-

istence with the depersonified rainbow, or reduce it to the state of a thing, but even then invest it with a marvelous function. Some have made of it a celestial bow, which they place in the hands of a god; with the Lapps, it was the bow of the god of the thunder, by means of which he shot off his arrows of fire; with the Australians, it was the *phallus* of the god of the sky, which grazed the earth as it passed; with the Samoyeds and the Kamtchatdales, it was the hem of the clothing of Billoukai, the god of the thundering sky; and among the classic ancients, it was the scarf of Iris, the fair messenger of the gods. In Polynesia and with the Germans, Hindoos, Persians, and Arabs, the rainbow was regarded as a bridge uniting the abode of the gods with that of men; the road over which souls traveled; with the Jews, it symbolized the alliance of God and man; with the Greeks and Romans, it was a sign of war or of storms.—*Translated for the Popular Science Monthly from Ciel et Terre.*

THE FUTURE OF THE AMERICAN INDIAN.

By THOMAS J. MAYS, M. D.

IT is quite evident that the history of the American people would be very different from what it is, or from what it will be, had they not on the very threshold of their existence encountered a race of warlike savages, and had not their stability been still further threatened by a later introduction of slave labor from Africa. Had the immigration to this country been strictly confined to members of the Caucasian family, there would undoubtedly exist a mutual feeling of physiological and social harmony—since they all stand on a plane of civilization which is common to the American; but so soon as the latter came in contact with races which were aliens and strangers to the Anglo-Saxon blood, and which were several thousand years behind it in point of civilization, an inevitable clashing of interests began which prevails to this day, and which will continue until the race differences are eradicated. No one, however, who has given serious attention to the political and social questions of this country can fail, even at this day, to perceive that, in spite of statutes and of prejudices, there are influences at work which tend to fuse our heterogeneous population into one common whole. Whether these influences are active so far as the colored or negro race is concerned is not very readily determined, since accurate statistics bearing on this point are wanting; yet indirect evidence, inconclusive as it may be, strongly favors such a view. The remarks in this paper will, therefore,

be confined to an inquiry as to how far these influences obtain among our North American Indians, since we possess more reliable data concerning this than that of the negro race.

Quite recently I had the opportunity of making an investigation into the type of respiration as it exists in the Indian female, and I then unexpectedly found that a large proportion of the Indian girls which were examined had white blood coursing through their veins, and that this not only modified the color of their skin, but also had a marked influence on their mode of breathing. It is well known that, as far back as 1774, Boerhaave observed a different type of respiration in civilized man and woman—the former breathing principally with the diaphragm or abdomen, which is called the abdominal type; while the latter breathes principally with the upper portion of the chest, which is called the costal type. This investigation was carried on in the Lincoln Institution of Philadelphia—a school for Indian girls—and was undertaken with a view to ascertain whether the Indian female, who is not accustomed to the wearing of corsets and tight clothing around the abdomen, has the same type of respiration as that which obtains among our civilized females, and in all I examined the chest-movements of eighty-two Indian girls by means of a pneumograph devised by me somewhat after that of Paul Bert. In each case I took an abdominal and a costal tracing. Of the eighty-two girls which were examined, and whose ages ranged between ten and twenty years, there were only thirty-three full-blooded Indians; five were one fourth, thirty-five were one half, and two were three-fourths white. Seventy-five girls showed a decided abdominal type of breathing, three a costal type, and in three both were about even. Those who showed the costal type, or a divergence from the abdominal type of breathing, came from the more civilized tribes, like the Mohawks, Chippewas, etc., and were either one half or three fourths white, while in no single instance did a full-blooded Indian girl possess this type of breathing. This is significant in showing that, so far as the Indian is concerned, the abdominal type is the original type of respiration in both male and female, and that the costal type in the civilized female is acquired through the constricting influence of dress around the abdomen. That which is of still greater importance, however, is the fact that only those girls who were either one half or three fourths white, and who were hence under the greater domination of the inherited characteristics of civilized blood, possessed the costal or an approach to the costal type of respiration.

An examination of the pupils of the Lincoln Institution, therefore, not only shows that a rapid amalgamation is taking place between the white and the Indian races, but that the latter is

also acquiring some of the physiological peculiarities of the former. This blending of white and Indian blood is still further confirmed by the varied composition of the Indian male pupils in the Educational Home for Indian Boys in Philadelphia, as is shown by the report of this institution for 1886. From this source we learn that among the one hundred and seven boys there were only thirty-eight full-blooded Indians; of the remainder one was three fourths, sixty-one one half, and seven were one fourth white. Similar testimony comes from the reports of the Commissioner of Indian Affairs. These reports not only show the existence of a very large proportion of mixed bloods among the 250,000 Indian population of this country, but also a marked increase of the former during the years 1885 and 1886—the only years in which a record of the total number of mixed bloods is supplied. Thus, in the year 1885 there were 18,412 and in 1886 there were 20,567 mixed bloods, an increase of more than 2,000 during one year. The pure Indian population for the former year was 259,244, and for the later 247,761, a decrease of over 11,000 during the same time.

It is furthermore evident from these reports that the number of mixed bloods in each agency is very naturally determined by the length of time which the Indians have been exposed to contact with the white race, as is shown by the following table, where are given the names of various agencies, the Indian population in each one, the number of mixed bloods in each, the proportion of mixed bloods to Indian population, and the dates of treaty:

No.	NAME OF AGENCIES.	Indian population in each agency in 1886.	Number of mixed bloods in each agency in 1886.	Proportion of mixed bloods to Indian population of each agency in 1886.	Date of treaty—showing the length of contact between the white and Indian.
1	New York, N. Y.....	4,961	2,890	1 to 2	1797
2	North Carolina, N. C.....	3,000	1,000	1 to 3	1833
3	Cherokee, Ind. Ter.....	22,000	7,633	1 to 3	1833
4	Osage, Ind. Ter.....	905	456	1 to 2	1839
5	Green Bay, Wis.....	2,000	1,309	1 to 1½	1848
6	White Earth, Minn.....	5,885	1,013	1 to 5	1855
7	Mackinac, Mich.....	9,572	5,700	1 to 1½	1855
8	Colorado River, Ariz....	2,527	2	1 to 1,263	1865
9	Shoshone, Wyom. Ter....	1,800	16	1 to 112	1868
10	Cheyenne River, Dak. Ter.	2,965	158	1 to 18	1868
11	Pine Ridge, Dak.....	4,973	445	1 to 11	1868
12	Fort Hall, Idaho	1,444	30	1 to 48	1868
13	Colville, Wash. Ter.....	2,350	35	1 to 67	1872
14	Sac and Fox, Iowa	380	None.	.....	1882
15	Pima, Maricopa, and Papago, Ariz.....	12,050	6	1 to 2,008	1883

NOTE.—It may be stated that the dates of treaties may not be absolutely correct.—AUTHOR.

After making due allowance for the remote location of some of the oldest agencies, this table shows very conclusively that the mixed bloods are most numerous in those tribes that have been longest in contact with the white race. This is illustrated by the first seven agencies. Of course this is quite natural, but it demonstrates still further that in the older agencies, like those of New York, Green Bay, and Mackinac, there are nearly as many mixed as pure bloods. This is indeed surprising, for, if we consider the fact of the increase of the mixed bloods in connection with the fact that the pure Indian is probably decreasing in numbers, it is quite evident that the day will not be far distant when the remnant of the once proud American Indian will be incorporated into the white race.

This, then, so far as the American Indian is concerned, is the natural drift of things as best it can be divined at the present time, and that which becomes of absorbing interest to us is the question of the stability of this new product. Will it be better able to resist disease and death than the original Indian stock, or will it, like the latter, tend to disappear because there is a want of harmony between itself and its surroundings? While this question can not be determined positively on account of a lack of reliable statistics, there are reasons for believing that the offspring of such an alliance is stronger and more vigorous than the pure Indian. This is in accord with what might have been expected on *a priori* grounds alone, for the mixture of a lower with a higher blood will certainly improve the nature of the former, while it will just as certainly impair that of the latter.

The experience of the teachers of the Lincoln Institution confirms the views here expressed, that the mixed Indian is more exempt from pulmonary disease than the pure Indian; and, further, that if the former are attacked by disease, they offer greater constitutional resistance to it than the latter. This view is also confirmed by the large experience of Captain R. H. Pratt, Superintendent of the Carlisle Indian School, who says in his last report:* "Our experience is, that the mixed bloods resist disease and death from pulmonary troubles better than the full-bloods; and our best health conditions are found among those we send out into families—due, I think, very largely to the regular occupation and varied diet."

Similar views have been expressed by others† who have resided among the mixed or half-breed races in the northwestern part of Canada. These people are said to be strong and hearty, long-lived, and not subject to disease, so long as they remain in

* See Report of Indian Commissioner for 1886, p. 22.

† See "Mixed or Half-Breed Races of Northwestern Canada," by Dr. A. P. Reid, "Journal of the Anthropological Institute," 1874, vol. iv, p. 45.

their native climate. They regard themselves as the equal of the whites, and look in a patronizing way on the Indian. Their families are usually very large, and the female sex is said to be very handsome.

Quite recently I had occasion to investigate the question whether *pulmonary consumption tends to exterminate the American Indian?** and I then found that nearly all those Indian agencies which show the lowest consumption rate are precisely those which are shown in the table of this paper to contain the largest number of mixed bloods. Of course, it is just possible that the presence and the absence of pulmonary consumption in certain tribes is purely a coincidence; yet I think, from what has been said concerning the improved physical condition of the mixed Indian, it is quite evident that the greater immunity of these tribes from consumption is due to the fact that they comprise a large element which has a superior power of warding off disease.

These facts and inductions obviously show that Nature steps in and adds more toward a solution of the difficulties of the Indian problem than statesmanship has ever accomplished. Such a process, although at the beginning it acts prejudicially to the interests of the white race, will in the end operate to the advantage of both races. There can be no doubt that the harmony of feeling which it establishes, and the permanency of common interests which it insures, counterbalance all the evils which it ever inflicted. Moreover, these developments also confirm the wisdom of the course of our Government, and that of our philanthropic people who have undertaken to second these efforts of Nature, by educating and training the growing generation of Indians in the ways of civilization and of Christianity.

DARWINISM AND THE CHRISTIAN FAITH.

I.

THE publication of the "Life and Letters of Charles Darwin," a review of which has already appeared in the pages of the "Guardian," seems a fitting opportunity for attempting to face the question how far Darwinism affects Christian faith, and what are the points of traditional interpretation or apology which are modified by it. Christian theology has no fear of scientific discoveries. It claims all truth as belonging of right to Him who is the Truth. But Christian theologians are but slowly learning that panic fear of new theories is as unreason-

* See "New York Medical Journal," for May 7, 1887.

able as the attempt to base the eternal truth of religion on what may eventually prove to be a transient phase of scientific belief.

With regard to evolution, however, we are dealing with what may fairly claim to be an established doctrine. Certainly it is not too much to say that in the scientific world it has won its way to security, and has brought over to its side the vast majority of those who have a right to give an opinion on the scientific question. In saying this, however, we do not mean that evolution is stereotyped in the form in which Darwin gave it to the world. No one would more indignantly resent such a possibility than Darwin himself. And it is remarkable that the year which told us the story of Darwin's work and life, found us face to face with two attempts to carry out the doctrine of evolution in different, and as it seems, mutually inconsistent lines. In the July number of the "Journal of the Linnæan Society," 1886, Mr. Romanes propounded a theory—perhaps we should more properly say suggested for consideration a theory—to which he gave the name of physiological selection. Last year, thanks to two excellent articles in "Nature," by Prof. Moseley, and a paper at the British Association on "Polar Globules," we were introduced to Prof. Weismann's "germ-plasma" doctrine.

What is commonly known as Darwinism includes in it two elements which are by no means necessarily connected—the one the Lamarckian theory of descent, the other the more strictly Darwinian theory of natural selection. We had got so accustomed to being told that the experience of one generation became the instinct of the next, and that the transmission of acquired habits was one of the most important as well as the most obvious factors in the variation in species, that it is somewhat startling to be told now that there is no verified case of the transmission of acquired characters, and that the Lamarckian doctrine of descent was never essential to Darwinism, though it existed as a survival in it. Yet this, in short, is Prof. Weismann's view, and it was received with general favor at the Manchester meeting of the British Association. It would seem to those who speak without special knowledge that the two views advocated respectively by Mr. Romanes and Prof. Weismann are mutually incompatible, and that the latter view if adopted would be fatal to some of the most cherished theories of Herbert Spencer. According to Mr. Romanes, "natural selection is not a theory of the origin of species."* According to Prof. Weismann, natural selection is the main cause of such variation. Mr. Romanes talks of the "swamping effects of intercrossing," while Prof. Weismann sees in every case of sexual reproduction a multiplication of the possibilities of adaptation to an unfavorable

* "Journal," p. 398.

environment. Finally, Mr. Romanes postulates a highly variable reproductive system of which no explanation is given, and by this he would explain the sterility of species *inter se;* Prof. Weismann carries us back to the Protophyta and Protozoa, where strictly speaking there is no reproduction, and to the direct action of environment upon these, from which, in the Metaphyta and Metazoa, by sexual reproduction we get "spontaneous" tendencies multipled in geometrical ratio. These "spontaneous," or, as we prefer to call them, "inherent" tendencies or characters, are transmissible; acquired characters are not. We trust we have not misrepresented these views. We notice them not in the least with a view to deciding between them, though there is little doubt which way the balance of scientific authority at present inclines; still less with the wish to make capital out of their disagreement, but in order to emphasize the fact that, while Darwinism is generally accepted in the scientific world, there is much which as yet is unsettled; in other words, that, while every competent man of science now believes in the origin of species by progressive variations, we can not be too much on our guard against stereotyping any theory as to the proximate causes. It is nearly as true now as when Darwin wrote it in 1878 that, though "there is almost complete unanimity among biologists about evolution, . . . there is still considerable difference as to the means, such as how far natural selection has acted, and how far external conditions, or whether there exists some mysterious innate tendency to perfectibility." *

In the present and a future article we propose to deal with the doctrine so far as it is generally accepted by scientific men, and, without attempting to discuss the evidence on which the doctrine rests, to answer the following question: Given a Churchman who accepts the dogmatic position of the English Church on the one hand, and who, so far as he is able to understand it, believes the doctrine of evolution to be the truest solution yet discovered by science of the facts open to its observation, what reconstruction of traditionally accepted views and arguments is necessary and possible? How is he to relate the new truth with the old?

In so stating the problem we put out of court three classes of persons: (*a*) those who, intrenched in the fortress of religious certainty, are content to leave intellectual problems alone and ignore the movement of scientific thought around them; (*b*) those who are so "immersed in matter" that the religious side of their nature has become atrophied by disuse; and (*c*) those who possess the wonderful power of keeping their intellectual and religious life "sundered as with an axe," who, if they were chal-

* "Life and Letters," ii, p. 412 (American edition).

lenged to give a theory of human nature, would have to represent it as if it were a modern ironclad built in water-tight compartments.

In contrast, then, with these three classes we take the case of an ordinary Churchman with perhaps something more than the ordinary intellectual and speculative interests, and certainly with more knowledge of what is *de fide* and what is not, than most Churchmen possess; a man who rejects the modern panacea of indefiniteness, and refuses, even though he might claim the precedent of a Homeric goddess, to throw over the battle-field "a nimbus of golden mist" to cover the retreat or defeat of a favorite hero. Such a man, accepting Darwinism, will expect not only that a reconstruction, or at least a resetting, of his beliefs will be necessary, but also that real effort, moral and intellectual, will be required for the work. No new truth can, without effort, be related with the truth already appropriated by the mind, and the wider and more far-reaching the truth the greater the effort which will be required. This is why the in-rush of new truth means unsettlement, and perhaps, in the reconstruction, a renouncing of something which has been associated with spiritual truth, though not of the essence of the truth itself.

Dr. Asa Gray, the American botanist, writing to Mr. Darwin about the "Origin of Species,"* says: "It is refreshing to find a person with a new theory who frankly confesses that he finds difficulties, insurmountable at least for the present. I know some people who never have any difficulties to speak of."

In attempting to answer the question we have proposed to ourselves, we do not profess to be of the number of those happy or unhappy people who have "no difficulties." We can, at most, hope to remove some difficulties which are more apparent than real, and, with regard to others, to suggest hints which have helped us, in the hope that they may be of use to others:

1. The first difficulty which will probably occur to any one is this: Darwinism offers an explanation of the origin of species. How is this reconcilable with the first article of the creed, the first sentence of the Bible? A man of average intelligence will not hesitate long here, unless the issue has been confused for him by the one-sided statements of ignorant partisans. For science neither says, nor professes to say, anything about the ultimate origin of things. Mr. Darwin says: "I believe that all animals are descended from at most only four or five progenitors, and plants from an equal or less number.†. . . All the organic beings which have ever lived on this earth may be descended from some one primordial form."‡ And he adds, "There is grandeur in this view of life, with its several powers, having

* "Life and Letters," ii, p. 66. † "Origin of Species," p. 424. ‡ Ibid., p. 425.

been originally breathed by the Creator into a few forms or into one."*

Haeckel and some other evolutionists would go further. They would believe, though all the experimental evidence is at present against such a view, that life ultimately arose from inorganic matter. But even here there is no suggestion as to the ultimate origin of that matter, out of which all the world, as we know it, came. In the language of technical theology, evolution deals with secondary (i. e., derivative), but does not touch primary, creation. In Haeckel's less exact way of stating the distinction it deals with "creation of form," but knows nothing about "creation of matter." Of the latter, i. e., original creation, Haeckel says: "The process, if indeed it ever took place, is completely beyond human comprehension; and can, therefore, never become a subject of scientific inquiry."†

Prof. Tyndall, speaking of the "evolution hypothesis," says: "It does not solve—it does not profess to solve—the ultimate mystery of this universe. It leaves, in fact, that mystery untouched." Prof. Clifford again says: "Of the beginning of the universe we know nothing at all." Herbert Spencer, indeed, rejects primary creation, but not on the ground that evolution offers an alternative for it, but because it is "literally unthinkable"; and Prof. Huxley, on the ground that, as science knows nothing about it, nothing can be known. Q. E. D. But Mr. Darwin tells us that "the theory of evolution is quite compatible with the belief in a God";‡ that when he was collecting facts for the "Origin" his "belief in what is called a personal God was as firm as that of Dr. Pusey himself";*; while even at the time when the "Origin of Species" was published, he deserved to be called a theist."‖ Later on he says: "The mystery of the beginning of all things is insoluble by us; and I for one must be content to remain an agnostic." Yet, three years later (1879), in a private letter, he writes, "In my most extreme fluctuations I have never been an atheist in the sense of denying the existence of a God."△ These quotations, which of course might easily be multiplied, are enough to show that evolution neither is, nor pretends to be, an alternative theory to original creation. An evolutionist, therefore, who denies the fact of creation, goes as far beyond the evidence which science offers as if he had asserted his belief in "the Maker of heaven and earth."

2. But then evolution does clearly offer us a theory as to how the world came to be what it now is, and in this we are told it contradicts the Bible and the unvarying faith of Christendom. We have here a clear issue raised between two alternative the-

* "Origin of Species," p. 429. † "History of Creation," i, p. 8, English translation.
‡ "Life and Letters," i, p. 277. * Ibid., ii, p. 412. ‖ Ibid., i, p. 282. △ Ibid., i, p. 274.

ories—the one the theory of Darwin, the other the theory of "special creation," and they are mutually destructive. If the theory of "special creation" is true, Darwinism is false; if Darwinism is true, "special creation" is false. And this issue is plainly accepted by both parties. Thus Mr. Darwin says, "I have at least done good service in overthrowing the dogma of separate creations"; and Haeckel, in the preface to his "Evolution of Man," boasts that "when, in 1873, the grave closed over Louis Agassiz, the last great upholder of the constancy of species and of miraculous creation, the dogma of the constancy of species came to an end, and the contrary assumption—the assertion that all the various species descended from common ancestral forms—now no longer encounters serious difficulty." Darwin was fully aware of the opposition his theory would have to encounter. And he feared the men of science as much as the theologians. "Authors," he says, "of the highest eminence seem to be fully satisfied that each species has been independently created." When he first hinted at the theory to Joseph Hooker in 1843, he says, "I am almost convinced that species are not (it is like confessing a murder) immutable,"* and his utmost hope is that he may be able "to show, even to sound naturalists, that there are two sides to the question of the immutability of species,"† and that "allied species are co-descendants from common stocks."‡ Whether true or not scientifically, this does not sound like a dangerous heresy, and yet the outcry raised from the side of religion was as great as that raised by contemporary science. Even now religious people are surprised to be told that it is a purely scientific question, to be decided solely on scientific evidence, and to be dealt with effectively only by scientific men. It is not the question whether species were created by God or came into existence independently of him, or (as Huckleberry Finn puts it) "whether they were made or whether they just *happened*." For science repudiates chance—except as a name for unexplained causation—as earnestly as religion does. It is a question between two views as to secondary creation, or, more strictly, between a theory and the denial of the possibility of a theory as to the method of this creation. The question is this: Were species directly created at the first, or by intermediate laws, as individuals are?# Were they independently created, or descended from other species?‖ "To say that species were created so and so," says Mr. Darwin, "is no scientific explanation, only a reverent way of saying it is so and so."^ "Special creation" is here on the agnostic side, while evolution at least attempts to bring God's action in the past in line with his action

* "Life and Letters," i, p. 384. † Ibid., i, p. 389. ‡ Ibid., i, p. 393.
# Ibid., i, p. 394. ‖ Ibid., i, p. 437. ^ Ibid., i, p. 437.

in the present; his creation of species with his creation of individuals. According to special creation, forms of life are produced by the will of God; having, indeed, the minutest analogies to one another, and yet having no relation to one another. According to evolution, species are not merely created by God, but created by him according to a method which relates each species with the rest, and explains their analogies, like family likenesses, by a common ancestry.

We have purposely stated this in the language of religion, as Mr. Darwin not unfrequently does. But it is a purely scientific question; and Mr. Darwin, we think rightly, afterward expressed his regret at having used "the Pentateuchal term of creation,"* because of creation, in its strict sense, as ultimate origin, science knows and can know nothing. The question thus becomes one between those who hold and those who deny the immutability of species. The last are commonly spoken of as "Transmutationists"; the former might have been nicknamed "Immutables," but unfortunately they were too often called "Creationists," and the scientific issue was obscured for both parties by theological *animus*. Hence a belief in God as Creator came to be associated with the denial of transmutation, and a theory of transmutation was supposed to imply a rejection of the Christian creed.

It is really time that the doctrine of "special creations," which some theologians cling to so tenaciously, was held up to the light. Where did it come from? Who invented it? Everybody will at once say, "The schoolmen," because nobody reads the schoolmen, and people have a vague notion that "genus" and "species" are as much a monopoly of the schoolmen as are "entity" and "quiddity." But the schoolmen were transmutationists! They didn't believe in fixity of species any more than they believed in the uniformity of nature. For them the transmutation of plants was as possible as the transmutation of metals. The "reign of law," which is a commonplace with us, was unknown even in the days of Bacon. It is hardly credible to us that Lord Bacon, the father of modern science, as he is called, though he was only a schoolman touched with empiricism, believed not only that one species might pass into another, but that it was a matter of chance what the transmutation would be. Sometimes the mediæval notion of vivification from putrefaction is appealed to, as where he explains the reason why oak-boughs put into the earth send forth wild vines, "which, if it be true (no doubt)," he says,† "it is not the oak that turneth into a vine, but the oak bough, putrefying, qualifyeth the earth to put forth a vine of itself." Sometimes he suggests a reason which implies a kind of law, as when he thinks that the stump of a

* "Life and Letters," ii, p. 203. † "Natural History," Cent. vi, p. 522.

beech-tree when cut down will "put forth birch," because it is "a tree of a smaller kind which needeth less nourishment." * Elsewhere he suggests the experiment of polling a willow to see what it will turn into, he himself having seen one which had a bracken fern growing out of it! And he takes it as probable, though it is *inter magnalia naturæ*, that "whatever creature having life is generated without seed, that creature will change out of one species into another." Bacon looks upon the seed as a restraining power, limiting a variation which, in spontaneous generations, is practically infinite, "for it is the seed, and the nature of it, which locketh and boundeth in the creature that it doth not expatiate." Here the fact of transmutation is taken for granted, generation from putrefaction being sometimes called in as a *deus ex machinâ* to explain it. But Bacon certainly had no idea that the existing species of plants and animals represent those originally created by God, and this is what special creation means.

It might be supposed, however, that the doctrine of "special creation" was the private property of commentators, suggested by the account of creation given in Genesis. And there were, no doubt, those who so interpreted the words "after his kind." But Christianity was in no way committed to this view, while St. Augustine distinctly rejects it in favor of a view which, without any violence to language, we may call a theory of evolution. The greatest of the schoolmen deliberately adopted St. Augustine's views and rejected that of special creation. His words are so remarkable that they are worth quoting, especially as we have never seen them referred to in this connection:

> As to the production of plants, Augustine holds a different view. For some expositors say that on this third day (of creation) plants were actually produced each in his kind—a view which is favored by a superficial reading of the letter of Scripture. But Augustine says that the earth is then said to have brought forth grass and trees *causaliter*—i. e., it then received the power to produce them. This view he confirms by the authority of Scripture, which says, "These are the generations of the heaven and of the earth, when they were created, in the day that the Lord God made the earth and the heavens, and every plant of the field before it was in the earth, and every herb of the field before it grew." (Genesis, ii, 4.) Before then they came into being on the earth, they were made causally in the earth. And this is confirmed by reason. For in those first days God made creatures primarily or *causaliter*, and then rested from his work, and yet after that, by his superintendence of things created, he works even to this day in the work of propagation. For the production of plants from the earth belongs to the work of propagation.

Here, though there is no idea of the method by which the "kinds" were brought forth from the earth, or of their interrelations with one another, there is a clear conception of creation by

* "Natural History," Cent. vi, p. 523.

growth or evolution, which is quite contrary to what is known as special creation. And when we remember that the schoolmen held what is now called *abiogenesis* and generation from putrefaction, both in botany and zoölogy, we feel at once how infinitely more elastic their theory of Nature was than that implied in the doctrine of special creation. But if special creation is a doctrine unknown to Bacon and rejected by St. Thomas, it is not likely to be essential either to science or religion.

Where, then, did it come from? It includes elements both scientific and religious, and it is interesting to notice how the elements combined.

Half a century after Bacon's "Novum Organum" was published, a great poem appeared, which has since then, often unconsciously, influenced theologians and apologists. It is, no doubt, a thankless and ungenerous task to bring the heavy artillery of science to bear upon poetry, and it is only justifiable when truth is endangered. Some time ago Nasmyth, by the help of the "Nautical Almanac," discovered that, if Sir John Moore was buried "at dead of night," he could not have had the advantage of "the struggling moonbeam's misty light," because the moon must have been far below the horizon at the time. When this criticism was reported to the late President of the Royal Irish Academy by Sir R. S. Ball, he is said to have replied, "I'll tell you what it is, the time will come when that little poem will be taken as the sole authority about the matter, and all your astronomical calculations will go for nothing at all." This is very much what has happened in the case of "Paradise Lost." People have come to think of it as a sort of inspired gloss on the early chapters of Genesis. Yet there is a huge difference between the text and the commentary. In the Bible we have, "And God said, 'Let the earth bring forth,'" etc., words which are at least consistent with a gradual development. But Milton says:

> "The grassy clods now calved: now half appeared
> The tawny lion, pawing to get free
> His hinder parts, then springs as broke from bonds,
> And rampant shakes his brinded mane; the ounce,
> The libbard, and the tiger, as the mole
> Rising, the crumbled earth above them threw
> In hillocks; the swift stag from underground
> Bore up his branching head," etc., etc.*

This is literalism and realism with a vengeance! And yet it is hard to see why Milton should not do in poetry what Raphael in the Vatican had done in art.

But what gives such importance to the account of creation in

* "Paradise Lost," vii, 414, *et seq.*

'Paradise Lost" is, that it synchronized, curiously enough, with the first attempt to limit the logical term "species" to definite natural-history usage. This was the work of Milton's younger contemporary, John Ray, from whom the theory of the fixity of species may be said to date. Whether Milton influenced Ray, or Ray Milton, or whether the theory was "in the air," it is difficult to say. But in the next century, we find in Linnæus the meeting-point of Milton's *a priori* view of creation and Ray's unscientific doctrine of fixed species. The well-known words of Linnæus in the "Philosophia Botanica," "*Species tot sunt, quot diversas formas ab initio produxit Infinitum Ens, quæ formæ, secundum generationis inditas leges, produxere plures, at sibi semper similes*," * are thus the first formulation of the theory of special creation, which angry evolutionists attack and unwise apologists defend. In Linnæus's own time it came to be generally accepted, though questioned by Buffon, who contended for the modifiableness of species. Popular belief in the Linnæan doctrine seems to have been shaken by Cuvier at the beginning of the present century, and destroyed by Darwin's "Origin of Species"; and yet the dead hand of an exploded scientific theory rests upon theology, and Christians, in all good faith, set to work to defend a view which has neither Biblical, nor patristic, nor mediæval authority.

It is difficult *a priori* to see how the question, except by a confusion, becomes a religious question at all. Writing to a lady who had consulted him as to the bearing of evolution on theology, Mr. Darwin says, "I can not see how the belief that all organic beings, including man, have been genetically derived from some simple being, instead of having been separately created, bears on your difficulties"; † and at the close of the "Origin of Species" he had written, in the same spirit, "I see no good reason why the views given in this volume should shock the religious feelings of any one." ‡

The Bible, no doubt, in its vivid consciousness of the omnipresence of God, speaks of everything as wrought by him. He makes the grass to grow. He feeds the ravens. He clothes the lilies. He lets his breath go forth, and the beasts of the field are made. Children and the fruit of the womb are his gift. He covers the infant in the mother's womb, and fashions its limbs as they are made in secret. Does any sane man suppose that this conflicts with what we know of the laws of growth and generation, or that it implies an obliterating or an abridgment

* [There are as many species as there were different forms produced in the beginning by the Infinite Being, and these forms, according to the prescribed laws of reproduction, have brought forth abundantly, but always like themselves.]

† "Life and Letters," ii, p. 247. ‡ P. 421.

of what we call natural processes? There is no doubt that a theory of "special creation," as against "creation by derivation" (for this is the true antithesis), possesses a strange attraction for some minds, just as some cling to a Calvinistic theory of "immutable decrees," though at the price of making God an arbitrary, if not immoral, despot. But we do not really make God more mighty by ascribing to him actions which are unintelligible, nor do we derogate from his power by showing that the Maker of heaven and earth is not autocratic, or capricious, or irrational, but works according to law.

It may, however, be said: "Creation is a great mystery. Why attempt to theorize about it? To speculate upon a mystery is to rationalize it." There seems to be only one answer to this objection, and it is that reason is the gift of God and not of the devil, and therefore it can not be wrong to try and understand what we believe. Preaching at St. Paul's on Christmas-day, on the supreme mystery of the Incarnation, Dr. Liddon says:

> It was perhaps inevitable that the question should be asked, How such a union of two natures which differ as the Creator differs from the creature—as the infinite differs from the finite—was possible? It might be enough to reply that with God all things are possible—all things, at least, which do not contradict his moral perfections—that is to say, his essential nature. . . . But, in truth, it ought not to be difficult for a being possessed of such a composite nature as is man to answer this question.

And he proceeds to draw out the analogy suggested and justified by the Athanasian Creed, "As the reasonable soul and flesh is one man, so God and man is one Christ." If it is not wrong, nay, if it is a very necessity of Christian reason to ask how the union of God and man is possible, it can not be wrong to ask, How is creation possible? and to answer it by the analogy of what we see and know.

But the moment this question is asked in the present state of scientific knowledge, two things become increasingly apparent: (*a*) the enormous difficulties which on the theological side alone a theory of "special creation" has to face; and (*b*) the remarkable gain to theology if evolution rather than "special creation" is true. In both cases we propose to put the scientific evidence for evolution on one side, and treat it as a bare hypothesis.

(*a*) Nothing has brought out the difficulty of the "special creation" theory more strongly than the modern science of comparative embryology. It has added enormously to our knowledge of the existence of (apart from its suggested explanation of) rudimentary organs, and rudimentary organs have always been a difficulty in the way of the "special creation" hypothesis. Take the case of the whale. As Prof. Flower pointed out at the Reading Church Congress, it possesses in the embryo state a

complete set of teeth, together with rudimentary hind-legs, furnished with bones, joints, and muscles, of which there is no trace externally. Both teeth and legs disappear before birth. On the theory that the whale is a descendant of a land-animal, which used both legs and teeth, they are intelligible as survivals in a creature to which they are apparently useless. But that God should have created these structures in a new being, which had no organic relation with other created forms of life, seems almost inconceivable. We can neither believe that they were created "for mere sport or variety," nor that they are "Divine mockeries," nor as an ingenious but anthropomorphic writer in the "Spectator" suggested, that God economically kept to the old plan, though its details had ceased to have either appropriateness or use. The difficulties are even stronger in the case of man and the now well-known facts of his embryonic life. How is it possible, in the face of these, to maintain that we have in man a creation independent of the rest of God's creative work? Of course, if the theory of "special creation" existed either in the Bible or in Christian antiquity, we might bravely try and do battle for it. But it came to us some two centuries ago from the side of science with the *imprimatur* of a Puritan poet. And, though scientific men are now glad to palm off upon theologians their own mistakes, religion is not bound to wear, still less to be proud of, the cast-off clothes of physical science.

(*b*) On the other hand, and again apart from the scientific evidence in favor of evolution, *as a theory* it is infinitely more Christian than the theory of "special creation." For it implies the immanence of God in Nature, and the omnipresence of his creative power. Those who opposed the doctrine of evolution, in defense of "a continued intervention" of God, seem to have failed to notice that *a theory of occasional intervention implies as its correlative a theory of ordinary absence.* And this fitted in well with the deism of the last century. For deism, even when it struggled to be orthodox, constantly spoke of God as we might speak of an absentee landlord, who cares nothing for his property so long as he gets his rent. Yet anything more opposed to the language of the Bible and the Fathers can hardly be imagined. With St. Athanasius, the immanence of the divine Logos is the explanation of the adaptations and unity of Nature, as the fact that man is *logikos* is the explanation of the truth that man is made in the image of God. Cataclysmal geology and special creation are the scientific analogue of deism. Order, development, law, are the analogue of the Christian view of God.

We may sum up thus: For Christians the *facts of Nature* are the *acts of God.* Religion relates these facts to God as their author; science relates them to one another as integral

parts of a visible order. Religion *does not* tell us of their interrelations; science *can not* speak of their relation to God. Yet the religious view of the world is infinitely deepened and enriched when we not only recognize it as the work of God, but are able to trace the relation of part to part—to follow, if we may say it reverently, the steps by which God worked, to eliminate, so far as possible, from the action of Him, "with whom is no variableness, neither shadow of turning," all that is arbitrary, capricious, unreasonable, and even where as yet we can not explain, to go on in faith and hope.—*The Guardian.*

SKETCH OF GUSTAV ROBERT KIRCHHOFF.

THE history of physics in our century is not poor in eminent thinkers and great investigators; but it is safe to predict, as Prof. August Heller remarks, that when the student of a future age takes his perspective view of the achieved results of our contemporary research, he will pronounce Kirchhoff one of the greatest of them all. Yet, although his works have made his name immortal, and must cause it always to be in mind where physics is taught, so simple and modest was he as he is presented to us in Robert von Helmholtz's delineation of him, that his person is quite hidden behind the science to which he devoted his life; and that few, except fellow-laborers in the same lines and those who were so happy as to have had close relations with him, are aware of the extent and importance of his labors outside of the field of spectrum analysis.

GUSTAV ROBERT KIRCHHOFF was born—the son of counselor-at-law Kirchhoff—at Königsberg, Prussia, March 12, 1824. Having passed the course of the Kneiphof Gymnasium, he continued his studies at the Albertina in his native city, under Neumann in physics, and Julius Richelot in mathematics; and there, in his eighteenth year, decided that physics was the branch that pressed the strongest claims upon his attention. It was a period of rapid progress and important discoveries in science. Mayer had published his first paper concerning the forces of inanimate Nature, on the eve of the working out by several independent observers of the law of correlation and conservation; the undulatory theory of light had been established, but its mathematical conditions and its adjustment to facts remained to be worked out; and the wonderful properties and powers of electricity were under investigation by students at different centers, whose names have since become identified with various aspects of electrical theory. Kirchhoff, now entering upon the study of these same

and related branches, was one of those fortunate young men, says Prof. Heller, who appear, by the nature of their faculties, to be specially adapted to their calling. His rare mathematical talent adapted him to the use of analytical aids to such an extent that he could always readily bring the best methods to the solution of any problem. On September 4, 1847, he took his degree from the University of Königsberg. In the following spring he began his professional career at the University of Berlin as a *Privat-Docent*. He had already, while a student, in 1845, published a paper in Poggendorff's "Annals" on electric conduction in a thin plate, and specially a circular one, to which were appended two theorems which have since become generally known as Kirchhoff's laws. This was followed by other valuable papers on electrical questions, among which were those on conduction in curved sheets, on Ohm's law, on the distribution of electricity on two influencing spheres, on the discharge of the Leyden jar, on the motion of electricity in submarine cables, etc. Among them also is a paper on the determination of the constant on which depends the intensity of induced currents, in which is involved the absolute measurement of electric resistance in a definite wire.

In 1850 he was appointed Extraordinary Professor and Co-director of the Physical Institute in Breslau, where he remained four years, and formed a life-long fellowship and scientific brotherhood with Bunsen. In 1854, Bunsen having preceded him thither, he removed to Heidelberg, where he had been chosen regular Professor of Physics, in place of Jolly, who had been transferred to Munich. Here he lived and taught for twenty years, the bloom-period of his life. The brightest days in the history of this great university, to whose fame and pre-eminence Kirchhoff contributed very materially, fell during the same period. To the general public, says Robert von Helmholtz, hardly anything was then known of Kirchhoff. His labors at Berlin and Breslau, being in a field wholly theoretical, had attracted the attention only of experts. "There was, therefore, some surprise in Heidelberg when the slender, remarkably youthful, modest, even bashful North German appeared, heralded by Bunsen's warm recommendations. His refined, animated speech, his courteous and attractive demeanor, his fine sense of humor and his wit, soon won him the liking of all men with whom he came in contact. He was, therefore, a welcome participant in all the social gatherings of the circle into which he fell. His friendship with Bunsen became very close. Bunsen was thirteen years his elder, strong and broad-shouldered, with a lively, commanding temperament, making his influence felt upon every one. The two men were thus quite different in their

outer aspects from one another; yet they not only pursued their great works in common, but also lived their daily social life together. They took walks in company in the environs of Heidelberg, and they traveled together during the vacations.

The discovery of the spectrum analysis is destined, like that of gravitation by Newton, and a few others, always to rank among the greatest achievements in the history of science. Newton had succeeded in separating white sunlight into its colored constituents. Wollaston had, in 1802, discovered the dark lines in the spectrum; and Joseph Fraunhofer had, independently, some ten years later, investigated those lines thoroughly, fixed the position of more than five hundred of them, and marked the principal groups with letters. Now, half a century afterward, Kirchhoff found the key to the remarkable phenomenon. For it is really the law of the relation of emission and absorption, as discovered by Kirchhoff, that furnishes the theoretical basis of spectrum analysis. More precisely expressed, this law declares that, for a given temperature and rays of the same color and polarity, the relation of the power of emission and absorption is the same for every body—that is, independent of the nature of the body. From this theorem it follows that a luminous body which sends out light-rays only of a certain wave-length, will also absorb rays only of the same wave-length. Under this law conclusions can be drawn from the dark lines of the solar spectrum concerning the constitution of the sun's atmosphere. Kirchhoff's first publication on this subject appeared in the monthly reports of the Berlin Academy for October, 1859. This short notice was followed by a rapid succession of papers describing the researches of the two investigators (Kirchhoff and Bunsen) upon the solar spectrum and the spectra of the elements.

While engaged in these investigations, Kirchhoff injured his vision by exposure to the glare of a clear spot in the solar spectrum, so that in later years he was obliged to spare his eyes. In 1867 he suffered an injury of his foot, in consequence of which he was for three years unable to get about except upon a perambulator or with the aid of crutches, and his health was affected for the remainder of his life. But the results of this personal mishap were seen in his physical life only, not in his labors.

In 1875 Kirchhoff accepted a call to the professorship of Mathematical Physics in the University of Berlin, after having previously declined two invitations to the same institution. Here he delivered for several years regular courses of lectures on the mechanics of solid and fluid bodies, the theory of heat and light, electricity and magnetism, mathematical optics, and special topics in hydrodynamics, electrodynamics, etc. "Whether life in Berlin," says Robert von Helmholtz, "is favorable to scien-

tific pursuits may well be doubted. The teacher, it is true, gains a wider, richer field of activity, but the investigator is robbed of a larger part of his time. Kirchhoff was, however, protected by his physical disability against most of the drive of the capital, and was able to labor as he had usually done. . . . His favorite work, and the one having the most enduring results, was his lectures on mathematical physics. His address was impressive by reason of the elegance and precision of his statement. Not a word was wanting, not a word was in excess; never an error, an obscurity, or an ambiguity. Remarkable also was the exactness of his calculations—a matter of extreme difficulty to laymen. The whole material arranged itself before the eyes of the class in the form of a nicely adjusted master-work of scientific art, so that every part exerted its full effect on the others, and to witness one of his deductions was a real æsthetic enjoyment. The complete understanding of his reasoning on these most difficult subjects implied, of course, some knowledge of the mathematical language which was his vehicle of thought; and it might happen, and did in fact sometimes happen, that a hearer could not comprehend why Kirchhoff made this particular deduction and not some other; but every one was able to follow his course of thought, consider it, and render it correctly. So that, paradoxical as it may appear, it was not impossible, without having really understood Kirchhoff, to reproduce his lectures from the notes into a respectable book. Kirchhoff was able to give his lectures uninterruptedly in Berlin for nine years. But we who heard him could remark the effort they caused him, and how he had to husband his strength. Yet he was always punctual, and the quality of his teachings was never depreciated. Finally, in 1884, the doctors forbade him to read; and although he was enabled to resume this his favorite occupation for a time, it was evident that his nervous system was shattered."

Besides the subjects we have already mentioned, Kirchhoff conducted a series of valuable investigations in the equilibrium and motion of elastic solids, especially in the form of plates and rods. His publications were not voluminous. His contributions to the Berlin Academy of Sciences are spoken of as having been about one a year. His collected papers (*Gesammelte Abhandlungen*), about fifty in number, were published in Leipsic in 1882, in a single volume. His lectures on dynamics (*Vorlesungen über mathematische Physik*), first published in 1876, have reached a third edition, at least. They are styled by Prof. Tait somewhat tough reading, but certainly recompensing the labor of following them. They form rather a collection of short treatises on special branches of the subject, than a systematic digest of it. His greatest work, "The Researches on the Solar Spec-

trum" (*Untersuchungen über das Sonnenspectrum*), was, almost immediately after its appearance, republished in an English translation. To these works, and the papers on radiation, partly mathematical and partly experimental, published in 1859 and 1860, which led up to the great work on the solar spectrum, he has added, so far as Prof. Tait has been able to discover, only three or four more recent papers, among which are one on the change of form which an elastic solid undergoes when it is magnetically or electrically polarized (*Berlin Abhandlungen*, 1884); a subsequent paper giving applications of the results in the same investigation; and additions to his paper on the distribution of electricity on two influencing spheres.

Prof. Heller says that Kirchhoff possessed in an eminent degree all the qualities most sought for in an academic teacher. Mr. Helmholtz sees in him the prototype of a genuine German investigator. The religion and object of his life was to seek the truth in its purest form, and express it with quite abstract unselfishness. He loved and cultivated science for itself alone, and deemed the slightest adornment or excursion from logical exactness in presenting it to be a profanation; while all mingling of it with personal motives or with the strife for honors or gain was most repugnant to him. As he acted in science, so did he in life; and what he recognized as a manly civic or official duty he pursued with logical thoroughness, divested of all personal motive. Winning amiability and goodness of heart were revealed in all of his personal intercourse, so that both in Heidelberg and Berlin he was one of the most popular of the academical teachers. He was fond of telling a story of how, when the conversation turned upon the question whether the Fraunhofer lines conveyed any information respecting the presence of gold in the sun, his banker asked, "Of what use is gold in the sun to me if I can not go and get it?" Afterward, having received an English gold medal for his discovery, he showed it to the banker, and said, "See, I have got some gold from the sun!" Having been compelled by his growing disabilities to retire from active life, Kirchhoff spent his last months with his family, preserving a living interest in the questions with which he had been occupied. He was never heard to utter a complaint, though he must have known that his powers were steadily passing away. Death came to him quite unexpectedly, while he was asleep, on October 17, 1887.

As described by Prof. Heller, he was of a stature rather under than above the average, with finely modeled, sharply cut features; having a high forehead, on which many years of continuous thought had engraved close and deeply cut wrinkles, while the penetrating glance of his deep-blue eyes bore witness to his habit of giving close attention to abstract thought.

CORRESPONDENCE.

A DIFFICULTY REGARDING EVOLUTION.

Editor Popular Science Monthly:

I did not see Mr. Royse's letter on this subject until to-day. As he desires an answer, I will say a very few words.

The substance of Mr. Royse's difficulty is this: The chicken comes from the egg—true; but the egg also comes from the chicken—the mature animal is evolved from the germ-cell, but the germ-cell is produced only by the mature animal. So has it been from the beginning. Which is first? Have we not quite as much evidence that the mature animal, as that the germ-cell or protoplasm, was first? Of the two, he thinks the former the more probable.

In answer, I would say that Mr. Royse is probably right. Life *did* commence with the mature organism. But, according to the evolutionist, the primal organism was both *germ-cell and mature;* for the germ condition and the mature condition, in the lowest forms of life, are identical. Such lowest forms, even now, can hardly be said to have an ontogenic history, for they simply divide and redivide without essential change. Life, the germ-cell and the mature organism, all came together at the same moment. How, we know not; but, once introduced, the theory of evolution gives the process of change during the geological history of the organic kingdom, and shows that it is similar to the ontogenic history of the higher organisms.

JOSEPH LE CONTE.

BERKELEY, CAL., *March* 9, 1888.

THE ECONOMIC OUTLOOK.

Editor Popular Science Monthly:

SIR: Readers of "The Popular Science Monthly" are greatly indebted to the Hon. David A. Wells for the large amount of valuable information which he has made both accessible and interesting in his recent articles on the "Economic Outlook in the United States." But, as could scarcely be otherwise, in handling such a vast mass of material as the extent of the discussion implies, he has sometimes fallen into errors of fact, to one of which I wish to call attention.

On pages 460 and 461 of the February number he says: "Forty years ago corn was shelled in the United States by scraping the ears against the sharp edge of a frying-pan or shovel, or using the cob of one ear to shell the corn from another. In this way about five bushels in ten hours could be shelled, and the laborer would receive about one fifth of the product."

Then Mr. Wells goes on to draw conclusions, giving the population of the great corn States as over 2,000,000, and saying it would be needful for the whole population to sit astride of pans and shovels for one hundred and ten days to shell the corn-crop of 1880.

Now, what are the facts? I have been over the great corn States mentioned, as well as Kentucky and Tennessee. I can go back more than forty years or even sixty, and know whereof I speak. Fifty years ago and more the farmer who wanted to convert his corn into whisky to send by flat-boat to New Orleans, thence to Cuba or Charleston, unloaded from one to two hundred bushels upon his barn-floor, and put from four to six horses to tramp it out, and in two hours he had 200 bushels shelled. This was vastly better than sitting astride a frying-pan or shovel and scraping off five bushels a day. I did it many times, and know just how it was done.

Again, when the farmer wanted to take a load of meal to the market, he threw a load of corn on his barn-floor, say forty bushels; then took the old-fashioned flail that hung in every barn, and in an hour he had his forty bushels shelled. This, too, was better than sitting astride his frying-pan or shovel. And let me say, for the honor of the "old flail" and its departed uses, that it was about as good a hand-sheller as any that were found in the old barns.

GRIFFITH MORRIS.

GLENDOWER, OHIO, *February* 8, 1888.

A CORRECTION.

Editor Popular Science Monthly:

SIR: My attention has been called to a misquotation from Dr. C. F. Taylor's paper on "Emotional Prodigality," which occurred in my article on "Emotions *versus* Health in Women," printed in the February number of your magazine. Referring to Dr. Taylor's argument that emotional disturbances conduced to certain abnormal conditions in children, I have used the terms *diseases of the spine* as coming under his notice. This is an unintentional misquotation, as Dr. Taylor uses the terms *lateral curvature* and *lateral distortion;* and, that my own thought was not of diseases, but of these abnormities, the context will show. In the same paragraph (page 505) the second quotation, to be entire, should read: "I may say that at least two thirds of all *lateral distortions* of the spinal column are directly traceable to mental overaction,

mainly, if not entirely, of an emotional origin. There can be no doubt that this is the fact, because not less than three fifths of those who consult me in the earlier stages recover without any other treatment than a careful abstaining from whatever excites undue emotions in the subject of the distortion." My quotations were made from memory, and I regret that this error occurred, as the distinction is an important one.

If you will kindly give me room for this correction in your columns, you will oblige,

Yours very truly,

MARY TAYLOR BISSELL, M. D.

NEW YORK, *March* 5, 1888.

EDITOR'S TABLE.

HON. DAVID A. WELLS ON ECONOMIC DISTURBANCES.

IN the present number of the "Monthly" will be found the concluding article of the very interesting and valuable series contributed to our columns by the Hon. David A. Wells. The subject which this able and well-equipped writer has so amply discussed is one, it is almost superfluous to say, of the very highest importance. The condition of the body politic is a matter to which no one with the slightest pretensions to intelligence can allow himself to be indifferent. Is it well with us, or is it ill with us, in the social state?—surely that is a question which none but the ignorant or the frivolous can regard as other than most momentous. In discussing "economic disturbances" Mr. Wells has had this question constantly in view. He has written not as a mere statistician, or as a devotee of the market, but as a statesman, as a patriot, as a friend of humanity. Our readers can not have failed to notice the large spirit of humanity that breathes through his articles. We venture to say that no similar series of articles was ever produced more free from national prejudice or the spirit of national selfishness. Mr. Wells has watched, and has interested himself in, the whole movement of civilization; and he has the happy art of communicating to his readers a similar enlargement of thought and sympathy.

In the earlier articles of the series attention was called to the universality, among the more advanced nations of the globe, of a condition of economic disturbance dating from about the year 1873, and continuing, with more or less of fluctuation, to our own day. The evidence offered as to the reality of the phenomenon is, in the fullest sense, demonstrative; indeed, the leading economists of all countries are fully agreed as to the fact; divergence of opinion only begins with the discussions of the cause or causes. Without wishing to participate in the discussion ourselves, we must express our conviction that, in singling out as the great cause of the prolonged crisis under consideration the rapidity with which modes and conditions of production and transportation have changed during the last fifteen years, our contributor is essentially in the right. The picture he has drawn of the fluctuations in special trades, including displacements of labor, consequent upon the progress of invention and discovery, is striking and powerful; and it is not a matter of surprise that, when attention is concentrated upon this picture, a very gloomy forecast is apt to be formed of the immediate future of society. With displacement of labor, we see destruction of capital, financial uncertainty, and a growing feeling, on the part both of employers and employed, that they are the sport of forces that can neither be controlled nor calculated. No sooner is equilibrium partially restored, through a dearly-purchased adaptation to new conditions, than some further discovery comes to throw everything once more into confusion; nor does any one know the moment when our

whole industrial system may not be shaken to its base by the introduction of some new force or process more revolutionary in its effects than all that has gone before.

Evidently what is wanted for the production and maintenance of the highest form of social well-being is not only a large command over the forces of Nature, but a reasonable measure of stability in the general conditions of life. The lack of such stability entails evils not only material but moral; and we are inclined, after a careful reading of Mr. Wells's pages, to believe that in our present social state the latter predominate over the former. If the question be asked, Have the working-classes, in point of fact, endured greater hardships during the last fifteen years than during the previous fifteen, or in past times generally? the answer, according to Mr. Wells, must be an emphatic No. We may, indeed, go further on the strength of the facts he furnishes, and say that, up to the present, wages have been pretty steadily rising, while the purchasing power of money has been increasing. As a result of this double improvement in the remuneration of labor, the whole standard of living among the wage-earners has advanced. The skilled mechanic or artisan can to-day enjoy more both of comfort and of luxury than citizens of substantial means could have done a generation or two ago. On the other hand, if we turn to the capitalist class, and ask whether their losses and perplexities have depressed their mode of living, or diminished the outward and visible marks of their prosperity, we read the answer in the handsome streets of all great cities, and their suburbs. M. de Laveleye remarked a few years ago, with special reference to continental Europe, that one of the most conspicuous facts of the age was the vast increase in middle-class wealth and luxury; and certainly the phenomenon challenges attention at least as powerfully in this country. The very "strikes" that have marked our time have in themselves afforded evidence of general prosperity, showing, as regards the strikers, the possession of resources on which they could fall back during the period of their voluntary idleness, and, as regards the employers of labor, an ability to withstand the derangement of business which the strikes must have entailed. The truth would therefore seem to be, that our "economic disturbances" have involved more of unrest and anxiety than of actual suffering. Society has been, naturally enough, in a nervous, excited condition, and men's minds have been filled with apprehensions of evil that fortunately has not yet come to pass. Such a condition is not free from danger. Man does not now, and never did, "live by bread alone." He lives also by formed habits, permanent associations, settled views, well-grounded hopes. Take away any of these, and you not only unclothe but actually unbuild average human nature. It is not enough to supply bread. The bread-eater, if he is to thrive in mind as well as in body, must be enabled to feel that it is not all a matter of chance whether he gets the bread or not, but that there is some regular provision in the general scheme of things whereby his labor and thought can be transmuted into sustenance for himself and those dependent on him.

This view of the matter can not, we think, receive too much attention. Some one, rising from the perusal of these articles, may be disposed to exclaim: "Oh, it's all right after all. I see that wages are better than they used to be, and the working-classes enjoy a great many comforts they were not accustomed to formerly, and there is more work to be done in the world than there ever was before. Why, everything is splendid!" No, everything is not splendid. On the material side we are prospering, but the deep unrest that pervades society is not a

healthy symptom; and before we take our ease we should see what can be done to moralize the existing conditions of industrial life, and to give to the world's workers a conviction that the action of natural and social forces is making for their good and will continue to do so in the future. How is this to be done? By any form of government action? Upon this point Mr. Wells does not give us all the light we should desire to have; but we thank him for having shown, in the matter of the sugar bounties and drawbacks and kindred measures, the futile character of government interference with trade. On the score of restrictive tariffs much might have been said. If the little, comparatively speaking, that has been done by different countries to force their sugar upon other countries has been productive of so much disturbance as Mr. Wells describes, to what a vast extent must the natural course of industry and commerce have been interfered with by the hostile tariffs that different nations have erected in order to shut out from their markets the cheap goods that other communities were prepared to supply! Had the commerce of each country been required to adapt itself simply to the natural conditions established in the world, there would have been far more of permanence and less of uncertainty in all business arrangements; and a natural equilibrium would have resulted, the benefits of which would have been shared by all countries alike. But with tariffs enacted either by irresponsible autocrats or by more or less purchasable majorities of representative assemblies, wholly incalculable elements have been introduced, with results as grievous to commerce in its broad aspects as would be the shifting of the stars to navigation. But more injurious still than any actual financial loss resulting from government interference has been the habit which has thus been cultivated in most countries of depending on the government or the legislature, not only to control the channels of trade, but to secure the national prosperity. With all our boasted intelligence we make an absolute fetich of the state. "Whence have these men this wisdom?" might well be asked regarding the men who undertake to make our tariffs, and say just how much of this or that foreign article we shall import, and how much we shall pay for a similar native product. But few, comparatively speaking, ask the question: the assumption is general that the man who is elected to Congress and placed on a committee is thereby invested with a wisdom and knowledge almost supernatural in their range.

For our part, we do not share the delusion. We do not believe that any man or body of men is wise enough to be intrusted with the task of fettering the industry of a nation or prescribing the extent to which its citizens shall trade with other nations. We do not believe that election to any representative assembly whatever confers such wisdom. Holding such views, we are far from looking to government for any help in the present crisis. The only help, as we conceive, that the governments of the world could give would be to cease their interference with many departments of life which they now undertake to control. Leaving, then, every form of state action out of the question, we believe that much good might be done by the dissemination in a condensed and striking form of such facts as Mr. Wells has so industriously gathered; and we learn with pleasure that it is that gentleman's intention to republish his essays in book form, with such modifications as will best adapt it to popular usefulness. If the working-classes could be brought to understand the action of economic and social laws, and if it could be made clear to them that up to the present their own position had been steadily improving, they surely would not be dis-

posed to find much fault with the present tendency of things. If they could be persuaded that the instability of business was due in no small degree to government interference with commerce and industry, and that it would be greatly to their advantage to rely on a world-equilibrium in business matters rather than upon one made and unmade by national tariff legislation, their influence would probably be thrown in favor of commercial freedom, instead of, as is now the case, mainly in support of commercial restriction. Could they also be made to realize that, if their present increased wages, coupled with comparative lowness of prices, leaves them in many cases still in the grip of what seems like poverty, it is because they allow their desires for the enjoyments of life to outrun even their enlarged means. Any one may land himself in misery who does that. Finally, it can never be superfluous to preach the ever true doctrine that the key to happiness is conduct. Of those who really feel imbittered against the existing condition of things how many can truly say that they have been true to themselves; that they have made the most of their opportunities; that they have not, by some want of self-control, marred their own careers? No social state could by any possibility be invented in which a certain number of malcontents would not be counted. With malcontents, who are so by defect of nature or faults of conduct, the hand of power must deal. There is much good to be effected, we firmly believe, by dealing with men as men, individually intelligent and individually responsible, and doing away as far as we possibly can with the preposterous notion that they are pawns to be moved hither and thither by manipulators of the tariff and other gentlemen of protective proclivities. Self-help founded on knowledge is the master-principle of individual and national salvation.

We invite special attention to three articles on "Darwinism and the Christian Faith," the first appearing in this number of the "Monthly," which were recently published in "The Guardian," the leading Church journal in England. These articles are spoken of as "remarkable" by the editor of "Nature," who further characterizes them as follows: "The author is anonymous, but is understood to be an Oxford College tutor, and Honorary Canon of Christ Church. The orthodoxy of 'The Guardian' is, we believe, unimpeachable. We notice, therefore, with gratification that not only is Darwinism thoroughly accepted and lucidly expounded by the writer in 'The Guardian,' but that he is an exceptionally well-informed and capable critic, whose scientific knowledge is varied and sound. The publication of these articles in 'The Guardian' is a proof that the clergy as a body are not so unwilling to accept new scientific views as might be supposed were we to regard Dean Burgon as a fair sample of his class." The other two articles of the series will appear in early numbers of the "Monthly."

LITERARY NOTICES.

EVOLUTION AND ITS RELATION TO RELIGIOUS THOUGHT. By JOSEPH LE CONTE. New York: D. Appleton & Co. Pp. 344. Price, $1.50.

THIS volume, by the Professor of Geology and Natural History in the University of California, is a notable contribution to a discussion perennial in its interest. No question to-day more profoundly stirs the minds of thoughtful Christians than how the philosophy of evolution shall modify their convictions. With every passing year it is becoming better understood that it is not with religion, but with theology, that science has had conflict. By a necessity, purely and simply historical, theology has united elements very diverse in value. Its core and essence, religion, has been presented in tenet and dogma always plainly limited by the time, place, and knowledge of creed-makers. With religion have been

associated primitive ideas of the divine mind and will—crude cosmogonies current at the beginning of recorded human observation. Conceptions, transient in character, have had alliance with religious sentiments, essentially permanent. When a traditional cosmogony, such as the Mosaic, is transmitted as of equal sacredness with religion, there is grave danger that science, in discrediting the cosmogony, may do hurt to religion. This danger is avoided when we discriminate between the transient and permanent elements in theology. There is not, and never was, any necessary connection between any theory of Nature's history and the kernel of religion—the sense of a supreme mystery behind Nature, the sense of moral obligation transcending utility, and the hope of everlasting life. The conflict which so many suppose to be between religion and science is more and more seen to be really between new science and old—if by stretch of courtesy primitive observation and theorizing can be called science at all. Timidity, half informed and careless in discrimination, imagines science to be intent on destroying the temple of religion, whereas its chiefest mission is to broaden and heighten it. The more intelligible Nature becomes to the student, the profounder his reverence for the Intelligence manifested in Nature. Evolution, as a philosophy, deals only with the history of Nature, not its origin; with its transformations, not its essence.

That evolution is truth, and axiomatic truth, Prof. Le Conte firmly maintains. His presentation of its proofs, though rapid, is masterly, and brought down to date. He sets forth the important and little appreciated work of Agassiz in this connection—his proof that the laws of embryonic development are also the laws of geological succession. Agassiz, however, holding as he did the doctrine of permanency of specific types, rejected the theory of the derivative origin of species. Prof. Le Conte then presents the factors of evolution tersely and concisely—the effects of physical environment, of the use and disuse of organs, of natural, sexual, and physiological selection. He brings forward evidence for evolution from the general laws of animal structure, incidentally discriminating between analogies and homologies. He compares the forelimbs of mammals, birds, reptiles, and fishes, part for part, in a specially able manner. Embryology is next summarized in proof of the derivative origin of specific forms, and the parallel between the development of an individual and of the species to which the individual belongs is brought out very forcibly. The significance of rudimentary organs—teeth in whales, the cæcum in man—is shown to depend solely on descent from forms wherein such organs were useful. Unexercised, they have dwindled, and tend to disappear. Evolution is next shown to be supported by the facts of geographical distribution. Isolation of the Australian continent at a remote geological era explains the primitive characteristics of its fauna and flora. The peculiarities of island-life, the rapid changes in organic forms during the last glacial epoch, and the recession of arctic species to the snow-line of the Alps and the high mountains of Colorado and California, are shown to be intelligible on no other hypothesis but that of evolution. Prof. Le Conte next surveys the testimony drawn from the artificial production of varieties, and presents with graphic illustration the law of cross-breeding.

While maintaining that the fact of evolution is certain, our author points out that all its laws are not yet fully understood. Among the difficulties which he considers are those of the uselessness in incipient stages of organs afterward developing into usefulness. In such stages, for example, fins probably commenced as buds from a trunk; it is difficult to see how as buds they could be of any use, and therefore how they could be improved by natural selection until they grew to efficient size, and especially until muscles were developed to move them. Again, in the case of a variety in a new and useful direction making its appearance, what has prevented its obliteration by cross-breeding with the parental form? Thus, while he holds the law of evolution to be even more surely demonstrated than the law of gravitation, Prof. Le Conte points out problems to which students may most profitably direct their powers of observation and generalization.

Because our author is thoroughly a man of science, he finds his knowledge in con-

cord with his religion. He sees that the theory of development demands a reconstruction of theology, and frankly says so. His own conceptions of the reconstruction necessary are modestly and clearly stated. His idea of Deity is that of a Being resident and immanent in Nature, who creates by means of natural law in a perfectly intelligible order. At the point in evolution where man became a morally responsible being, he deems the human soul to have been born. As physical evil has been the means, through the pain and struggle it has involved, of racial elevation, so he holds moral evil to be equally necessary for the growth of character. How, otherwise, he asks, than by the possibility of fall, could man have gained the strength to rise? Prof. Le Conte is instructive, suggestive, and candid throughout every chapter of his book. It will be fruitful and helpful to many who fear that the progress of science means the abolition of religion; that Darwin and Spencer have come to uproot sentiments which Galileo, Kepler, and Newton only elevated and deepened.

WEALTH AND PROGRESS: A CRITICAL EXAMINATION OF THE LABOR PROBLEM. By GEORGE GUNTON. New York: D. Appleton & Co. Pp. 382. Price, $1.

IN this book the author undertakes to establish a natural basis for industrial reform; to show how to increase wages without reducing profits or lowering rents; and to expound the economic philosophy of the eight-hour movement. Whatever may be thought of the sufficiency of his conclusions, the critic must admit that his doctrines and proofs are well thought out and clearly stated, without passion and without prejudice. The book really has a duplex origin, for its central thought was conceived and the first effort to state it was made by the late Ira Steward, the leader of the labor-reform movement in Massachusetts. Just before his death, in 1883, he made a request that Mr. Gunton should complete his unfinished work. This author had the advantage of extensive experience and exceptional opportunities for observation with industrial affairs, and had been a close student of economic questions. He perceived the magnitude and perplexity of the task imposed upon him, and has met it in the fashion of a manly thinker. This book contains about half of what he has to say, the presentation of the principles of social economics being reserved for another volume. The precise points considered in the present volume are the definition of the law and cause of increasing production, and the theoretical statement and historical establishment of the law of wages. Under the former head, the socialistic postulate, that "labor is the creator of all wealth," is shown to be fallacious, and it is maintained that—inversely to the general conception—the prosperity of the laborer is the basis of the capitalist's success. The "wages fund," Francis A. Walker's, and Mr. George's theories of the law of wages, are all dismissed as unsound, and the true theory is defined to be that "the chief determining influence in the general rate of wages in any country, class, or industry is the standard of living of the most expensive families furnishing a necessary part of the supply of labor in that country, class, or industry." This law is illustrated and enforced by a review of the conditions of workingmen's wages and modes of living in Asia and in Europe in the thirteenth and fourteenth centuries, and down to the nineteenth century. The standard of living is determined by the daily wants of the people concerned—not what they have vague desires to have, but what they will struggle to get. These wants regulate consumption, and that regulates production, and thus the prosperity of the capitalist and the community is determined. The standard of the wants is elevated by enlarging the social opportunities of the masses, but not by enlarging them faster than the capacity for enjoying them is augmented. The first step toward this end is a reduction of the hours of labor, for, without time to improve them, other means for promoting the same object —education, free lectures, public libraries, parks, museums, and art-galleries—are necessarily ineffectual. Yet this must be done wisely, and commensurably with the enlargement of other facilities; for, to give idle hours to a man who does not know how to use them aright, is only a curse. With this reduction, which it is proposed to make to eight hours a day, should go half-time schools for children at work under sixteen years of age. Among the immediate effects

of the measure proposed would be the employment of a great number of laborers who are now idle. The permanent effects would be most quickly seen in the younger laborers; for, by the application of half-time, "within a single decade every laborer of twenty years of age . . . would have had five, and many of them seven or eight years' daily contact with the educational, moral, and social influences of school life. It is clear, therefore, that the necessary consequence of the general adoption of the half-time school system alone would be not only to greatly improve and elevate the home, but to almost revolutionize the domestic and social atmosphere of the masses within a single generation." The effects of this system upon wages, production, and prices, on profits, and on rent, are next considered, and declared to be all beneficial. The feasibility of short-hour legislation is shown from the history of the measures in that direction that have been taken in England. The lessons which they teach are drawn from comparative reviews of industrial progress in England, continental countries, and the United States; the eight-hour and half-time system is presented as a social and political necessity; and the conclusion is expressed that if such a system could be uniformly adopted in the principal manufacturing countries, "its effect upon emigration, enforced idleness, business depressions, and upon real wages, together with the growth of intelligence and social character, would in twenty-five years change the face of the industrial and social institutions of Christendom."

We have received from Macmillan an *Elementary Chemistry*, by *Muir and Slater* ($1.25), and a *Practical Chemistry*, by *Muir and Carnegie* (80 cents), two books, adapted to university students, which are designed to be used together in learning the elements of chemical science. The former volume deals mainly with chemical philosophy, using descriptive matter to show the basis on which the principles of chemistry rest. Its companion embodies a course of laboratory work.

In the third edition of the *Manual of Analytical Chemistry*, by *John Muter* (Blakiston, $2), a considerable amount of special matter has been introduced, but, by means of a change in the style of printing, the bulk of the volume has been diminished instead of increased. This manual embraces both qualitative and quantitative analysis, and deals with organic as well as inorganic substances.

Sir *William Aitken's* little book on the *Animal Alkaloids* (Blakiston, $1) embodies a lecture delivered before the British Army Medical School, in which he summarizes the recent researches as to the poisonous effect of the leucomaines, and other substances formed within the body by the physiological processes.

The sixth edition of *Bloxam's Chemistry* has been issued (Blakiston, $4.50). This work includes both organic and inorganic chemistry, and its distinguishing features are its comprehensiveness and the large space it gives to technological applications of chemical principles. The number of experiments introduced is also large. The work has been carefully revised, and a large part of it has been rewritten for this edition. The first edition having appeared when metallurgy was still treated as a branch of chemistry, more space is devoted to it than is usual in modern chemical works. As the author had been for many years before his death, which occurred just after the present book had passed through the press, a professor in the Military Academy at Woolwich, England, the chemistry of the various substances employed in warlike stores is quite fully treated.

Prof. *Victor von Richter's Inorganic Chemistry* (Blakiston, $2) has reached a third American edition. The present edition contains a rather extended section upon the thermal behavior of bodies, and throughout the work frequent occasion is taken to call attention to the dynamical side of chemical reactions. The sections upon the pressure and condensation of gases, and that upon the dissociation phenomena, have also been considerably increased, while new facts relating to the elements and their derivatives have been introduced.

First Steps in Geometry, by *Richard A. Proctor* (Longmans, $1.25), differs from the common text-books on this subject in dealing mainly with the methods which the student should follow in finding out for himself solutions to geometrical problems. The

volume includes, also, notes to the first two books of Euclid, and added propositions.

Prof. *Proctor* has published, also, *Easy Lessons in the Differential Calculus* (Longmans, 90 cents), suggested, like the preceding book, by his own experience when a student under clumsy and unpractical teaching. In his treatment of the subject, he aims to show the need of a method of calculation dealing with variable quantities, and how such a method is to be used in practice. The integral calculus he has treated as a department of the differential.

Prof. *W. G. Peck* has added to his mathematical series an *Elementary Treatise on Analytical Mechanics* (Barnes, $1.65), which is intended to embrace all the principles of this science that are needed by the student of engineering, architecture, and geodesy. The methods and arrangement of the book are based on the author's long experience in teaching at the School of Mines, Columbia College.

The nineteenth edition of *Nystrom's Pocket-book of Mechanics and Engineering* (Lippincott, $3.50) has been revised and corrected by Prof. *William D. Marks*, who has added an elementary article on dynamic electricity, and one on the expansion of steam. In the form of notes, the reviser has stated some opinions of his own which differ from those of the author, and has given references to the literature of certain topics.

Higher Ground, by *Augustus Jacobson* (McClurg, $1), suggests a means of settling the labor question, which has become so troublesome. The author states the difficulty in a few pages, and then names as the remedy the extension of manual training to all the public schools of the country. He would meet the expense by a graduated succession tax. The latter half of the volume contains much information in regard to the courses and results of the training-schools in St. Louis, Chicago, Toledo, and elsewhere.

Another book which claims to solve the same problem is *Labor, Capital, and Money: Their Just Relations*, by *C. C. Camp* (D. W. Lerch, Bradford, Pa.). The author maintains that "the theory of Ricardo's law of distribution, and its modern renovation by Mr. George," are entirely fallacious. He charges the current commercial disturbances to the wrong use of money, and prescribes as a remedy the issuing of money in such volume as to reduce interest to the percentage of advancing wealth.

The Old South and the New, by *William D. Kelley* (Putnam, $1.25), consists of a series of letters describing the industrial and social condition of the people of the Southern States in 1887, as contrasted with their condition in 1867. The general tone of the book confirms the recent reports of wonderful enlivenment in the farm and garden districts of Florida, in the coal and iron country, and the new manufacturing cities of the South, while some mistakes that have been made are also pointed out.

Free Rum on the Congo: What it is doing, by *William T. Hornaday* (Women's Temperance Publishing Association, Chicago), concerns a question of vital interest to the friends of humanity, which is occupying a large degree of attention in all civilized nations. It is that of the unrestricted importation of liquors into Africa, which, under the license allowed by the Berlin agreement constituting the Congo Free State, has grown into a business of enormous proportions. The extent of it is shown by the grand total of 10,377,160 gallons—most of it adulterations of the vilest character—which were shipped thither in 1885 from five countries. The evils inevitable under such a traffic do not need to be described or named. Their magnitude is incalculable, and their effects are likely to endure through many centuries.

Slav or Saxon, by *William D. Foulke* (Putnam, $1.25), is a study of the growth and tendencies of Russian civilization, in which are briefly described the territory and the people of Russia, and the military autocracy, with sketches of Russian conquests, the history of Russia, the reforms of Alexander II, and the present despotism. The author urges Americans to give their moral support to England in the collision with Russia which is prophesied to take place in Asia.

The first number of a journal named *Congress* (The Congress Publishing Company, $1 a year) comes to us from Washington. Its purpose in life seems to be the dissipation of that troublesome surplus in the United States Treasury, for nearly everything which it proposes to advocate involves

heavy expenditures of public money, while it appears to have no interest in anything which tends to decrease taxation.

China: Travels and Investigations in the "Middle Kingdom," with a Glance at Japan, by General *James H. Wilson* (Appleton, $1.75), is an attractive book of travel, especially to the business man. It is the outcome of a trip to gather information as to the desirability of investing American capital in the building of railroads, and supplying other modern improvements in China. The natural features and resources of the country, the volume and methods of business, the bearing of government regulations and social customs on commercial affairs, and the attitude of the government toward alien enterprises, are all discussed. The book contains also sketches of Chinese and Japanese history, with entertaining descriptions of scenery, family life, amusements, and superstitions in both countries. A map of China accompanies the volume.

A great deal of information about a fascinating part of our own land is contained in *California of the South*, by Drs. *Walter Lindley* and *J. P. Widney* (Appleton, $2). The questions that would be asked by the tourist, invalid, settler, and investor here find full and definite answers. A description of the climatology of the Pacific coast comes first in the volume, and is accompanied by a colored climatic map of Southern California. In the second part of the book the overland trip to California, and the natural features, points of interest, hotels, trade, wine and fruit production, and mineral springs of the five southern counties are described, with statistics, maps, and illustrations. Short papers are added on "Comparative Valuation of Lands and Products," by General Nelson A. Miles; "Trees, Shrubs, and Wild Flowers," "Petroleum and Asphaltum," "Orange-Culture," "Public Schools," "Profits and Methods of Fruit-Raising," and "Ten Acres Enough," by other writers familiar with these special topics.

Under the Southern Cross, by *M. M. Ballou* (Ticknor, $1.50), is a gossipy account of the author's travels in Hawaii, Australia, Tasmania, and New Zealand. The purpose of the book is evidently to entertain rather than to instruct; not to furnish statistics for the merchant or student, but to contribute to the pastime of "fireside" traveling, which has so many devotees.

Section II of the special report on "The Fisheries and Fishery Industries of the United States" is *A Geographical Review of the Fisheries Industries and Fishing Communities for the Year 1880*, and is prepared by *George Brown Goode* and a staff of associates (United States Commission of Fish and Fisheries). The contents comprise separate papers on the fisheries of each of the Atlantic States, with accounts of the fisheries of the Gulf of Mexico, the Pacific coast, and the Great Lakes, and an appendix of "Historical References to the Fisheries of New England." The methods and results of these industries are described by towns and counties, and numerous tables of statistics are inserted.

The Bulletin of the United States Fish Commission, Vol. VI, for 1886, contains a very large number of letters from American and foreign correspondents of the Fish Commission relating to special topics in its department.

Geology and Mining Industry of Leadville, Colorado, with Atlas, by *Samuel F. Emmons* (United States Geological Survey, $8.40), forms Volume XII of the monographs of the Geological Survey. The investigation of this field was undertaken in 1879, and the report was practically completed in the fall of 1881, when an abstract of it was made, which has been published. The information is less timely now than it would have been immediately after it was gathered; for the thousands of persons who, a few years ago, were eager to know about the mines of Leadville, have either got the knowledge by experience—in many cases dearly bought—or have turned their attention in other directions. The development of the mines, too, has gone on rapidly, and the ores have begun to change from carbonates and chlorides to sulphides. Still, the thorough manner in which the work of the geologist in charge and his assistants has been done, and the liberal style in which it has been illustrated with lithographic and heliotype plates, make the mon-

ograph of permanent value. The first part of the report deals with the geology of Leadville, and of the Mosquito Range, to which is appended an account of the petrography of the district. Part II deals with the mining industry, and is followed by appendices on the chemical constitution of the ores and other rocks, and on smelting operations.

Mineral Resources of the United States for 1886, prepared by *David T. Day* (United States Geological Survey, 50 cents), is the fourth volume of a series devoted to the statistics of the mining industries. It appears that there has been a notable increase in the value of mineral products over 1885, the chief item in this gain being pig-iron. The volume contains a paper, by E. R. L. Gould, presenting the leading provisions of the mining laws of States east of the Mississippi River.

In his *Exercises in English Syntax* (C. W. Bardeen, Syracuse, N. Y.), Mr. *A. G. Bugbee* seeks to furnish a manual which shall give a large amount of drill and test work, without introducing any examples of false syntax. The last he regards as object-lessons in incorrect use, and of more than doubtful utility when employed in exercises for correction.

The Outline of Anglo-Saxon Grammar of Prof. *W. M. Baskerville*, of Vanderbilt University (A. S. Barnes & Co.), appears to be a well-composed work, clear and concise in its statements, and leaving no point without an intelligent endeavor to give it a satisfactory explanation—a thing which, in a language of the dark ages only, it is not always easy to do. A list of irregular verbs is added by Prof. James A. Harrison, of Washington and Lee University.

C. N. Caspar and H. H. Zahn, of Milwaukee, send us *Volapük: An Easy Method of acquiring the Universal Language, constructed by Johann Martin Schleyer*, prepared for English-speaking students by *Klas August Linderfelt*, Librarian of the Milwaukee Public Library (128 pages, 50 cents, paper; flexible cloth, 75 cents). Volapük is, so far as we know, the only serious extensive attempt that has been made to impose upon the public a language that has been deliberately manufactured in a scholar's study. As a novel experiment, and as a matter that may possibly throw some light on the way languages come into being and grow, we shall watch its fate with much interest. It is satisfactory to learn from Mr. Linderfelt that Volapük is not regarded as yet perfect; that Prof. Kirchhoff, of Paris, has already made some acceptable and accepted improvements in it; and that there is an authorized Volapük academy for the suitable regulation of these matters. This work is composed on the basis of Alfred Kirchhoff's *Hilfsbuch*; it has a key to the exercises and vocabularies, and it bears the marks of being the work of a competent hand.

We have sometimes wondered, if a universal language had to be imposed on mankind, why Italian, which is living and ready made, could not be chosen. Though not perfect, it fulfills most of the requisitions of the American Philosophical Society. It is absolutely phonetic; its word-roots are familiar to all European languages; its vocabulary, while ample, is modest in its proportions; its pronunciation is musical, and its structure is simple. Most of these points appear in Mr. *C. H. Grandgent's Italian Grammar*, (D. C. Heath & Co., Boston), which is the "result of an attempt to put into convenient form and the smallest possible compass all the grammar that the ordinary student in Italian will need." It is all contained, vocabularies included, in 124 pages; and the work is well done.

Prof. *Edward S. Joyne's German Grammar for Schools and Colleges* (Boston, D. C. Heath & Co.) is based on the "Public-School German Grammar" of Prof. Meissner, of Queen's College, Belfast, which is very popular in the United Kingdom. Some extension has been given to the scope of the work, with a view of fitting it to the wants of students of every grade, up to the point where the demand arises for the higher study of historical and scientific grammar. A college professor, who has examined the book carefully, describes it as characterized by a fullness of light everywhere, "and a fullness of matter that will in most cases suffice," and as demonstrating "how superior scientific methods are to the so-called practical methods."

Memoirs of an Arabian Princess, by *Emily Reute* (D. Appleton & Co., 75 cents),

is the autobiography of a princess of the house of Zanzibar who became the wife of a German gentleman and made her home in Hamburg. The lady was a sister of the Sultans Madjid and Bargash; and her book is of interest as giving a representation of family life in Eastern courts. A darkly shadowed portrait is drawn of Sultan Bargash.

The collection of Mr. *Beecher's Patriotic Addresses*, published by Fords, Howard & Hulbert, contains the more important addresses and contributions to periodicals made by Mr. Beecher in America and England, from 1850 to 1865, on slavery, the civil war, and the development of civil liberty in the United States. The list begins with the article "Shall we compromise?" written in 1850, during the pending of Mr. Clay's "Omnibus Bill," when the issue on which the country was to divide politically was for the first time clearly defined and set forth, and closes with the eulogy on Grant. The intervening addresses—even though we may not agree with the editor in giving Mr. Beecher prominence after Lincoln and Grant, to the exclusion of others, in influencing the destinies of the country—are as essentially a part of the history of the times as any other single series of events. Mr. John R. Howard, the editor of the papers, who was a close personal friend of the author, introduces them with a well-balanced review of Mr. Beecher's remarkable personality and his influence on public affairs. Excellent portraits are given of Mr. Beecher in his mature manhood, at sixty-five, and a year before his death; and portraits, which ought to have been better ones, of the prominent men of the anti-slavery controversy.

The latest volume of Mr. *Bancroft's History of the Pacific States* (The History Company, San Francisco) is marked the ninth, and is the sixth and concluding volume of the *History of Mexico*. It gives the story from 1861 to 1887, with accounts of the invasion by the three powers and the setting up of Maximilian as emperor; the struggle of the Mexicans against the usurpation, ending in its final overthrow and the execution of Maximilian; and the presidencies of Juarez, Lerdo de Tejada, Gonzalez, and Porfirio Diaz. The general progress and present condition of the country are summed up in Chapters XIX to XXVI, under the heads of "Government, Finances, and Military"; "Mining, Manufactures, and Fisheries"; "Commerce and Railroads"; "Agricultural Resources;" "Ecclesiastical Affairs"; "Society"; and "Education, Science, Arts, and Literature." Of the condition of science in Mexico, we learn that the National Observatory, established in 1878, includes a meteorological and magnetic observatory, and maintains relations with the chief observatories of foreign nations and with many scientific associations. The Central Meteorological Observatory was established in 1877. A geological society was established in 1875. The Geographical and Statistical Society has contributed to the diffusion of knowledge on many subjects, particularly in connection with Mexico. "The conclusion arrived at, after a fair investigation of facts, is that many sons of Mexico have made great strides in the acquisition of science, and that a number of them have excelled in its several branches, and are doing their part well in the transmission to others of the knowledge they possess."

Except in the reduction of the pages to crown octavo size, *The First Edition of Shakespeare*, published by Funk & Wagnalls, is an exact photographic reproduction of the first folio edition of 1623. This edition is very rare, and of great value, principally because it is the only authority for the texts of "The Tempest," "Macbeth," "Twelfth Night," "Measure for Measure," "Coriolanus," "Julius Cæsar," "Timon of Athens," "Anthony and Cleopatra," "Cymbeline," "As You Like It," and "A Winter's Tale." It possesses an additional temporary value in view of Mr. Donnelly's Bacon-Shakespeare speculations, which are derived wholly from the peculiarities of this text. These peculiarities being given here in exact fac-simile, those interested in the questions raised by Mr. Donnelly can by its aid make their own comparison of his deductions with his evidence.

The magazine entitled *Woman* (Woman Publishing Company, New York, $2.75 a year), whose first number was that for December, 1887, is largely literary in character, and devotes considerable space also to the religious, temperance, and political efforts of women. Household economy receives a moderate share of attention.

The National Sin of Literary Piracy, by *Henry Van Dyke*, D. D. (Scribner, 5 cents), is a clear and vigorous statement of the moral position of the American people with respect to the intellectual property of foreign authors. It is an excellent document for the campaign for international copyright.

Madam *Emma Seiler's* treatise on *The Voice in Singing* (Lippincott) comprises the chief scientific facts, many of them the discoveries of the author, which lie at the basis of the art of singing. At the outset of her career as a teacher of vocal music, Madame Seiler perceived the need of a scientific foundation for her art, but the best instructors in Europe were ignorant of the laws which she sought. Applying to Helmholtz, who was prosecuting an inquiry into this subject, she was permitted to take part in his investigations, and also made important discoveries by herself. Later she received further assistance in her studies from Du Bois-Reymond. This book opens with a brief sketch of the history of vocal music, and the subject is then treated successively on the physiological, physical, and æsthetic sides. The structure of the vocal organs is described in an appendix.

Canadian Leaves (N. Thompson & Co., New York) is the title of a series of papers on the history, art, science, literature, and commerce of Canada, read before the Canadian Club of New York. Among the contributors are Prof. Goldwin Smith, Hon. Benjamin Butterworth, Rev. George Grant, and Mr. Erastus Wiman. Mr. *G. M. Fairchild*, jr., is the editor. The volume is handsomely made, and is illustrated with portraits of the contributors, head-pieces, initials, and tail-pieces, by Thomson Willing.

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Chamberlain, Prof. J. H. The Genesis of Literature. Marietta College, Ohio. Pp. 24.

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POPULAR MISCELLANY.

The Meaning of Easter Eggs.—Larousse's "Dictionnaire Universel" says: "The use of Easter eggs is general among all the people of the different Christian communities. It appears to have been a symbolic tradition of the Christian Church, which has been explained in different ways. Some see in it a remembrance of the red egg which, according to Ælius Lampidius, a hen belonging to the parents of Alexander Severus laid on the day of his birth. Others trace it to the martyrdom which was inflicted upon Christians by the *ova ignita*. Among pagans, the egg had a mystic sense, relating to the origin of beings and of the whole world; and it is perhaps the case that this tradition was preserved, along with many others, in the new religion. The most probable interpretation, however, is that the Christian adepts saw in the egg, in view of the phenomenon of its hatching, a symbol of the resurrection of Christ; and hence the custom of carrying eggs to the temple on Easter-day to be blessed by the priest, which were afterward distributed to the family and friends. But it may be that there is in this nothing more than a joyful manifestation on the occasion of having again eggs of which the laity had been deprived during the whole of Lent."

The Audubon Monument.—We are glad to observe that the Audubon Monument Committee are moving as rapidly as the public will support them in their noble object of erecting a worthy monument to our first great naturalist. The enterprise is under the immediate care of our ornithological and scientific societies, in whose behalf the committees are acting; but contributions are desired and solicited from the general public. Audubon gave luster to the American name when it was in low esteem in science; and his service in literature was hardly less conspicuous. He was, moreover, a man of the people, who taught them and is still teaching them; and it is eminently proper that the people should unite in giving him the proposed testimonial of their grateful remembrance. The monument will be the first erected in America by popular contributions in honor of a scientific man; it is

expected to cost ten thousand dollars, and it is intended to stand in Trinity Cemetery, overlooking the Hudson, and not far from the Audubon mansion. All gifts will be publicly acknowledged. They may be sent to William Dutcher, No. 51 Liberty Street, New York. A committee of the Linnæan Society, consisting of L. S. Foster, C. S. Allen, M. D., and Jonathan Dwight, Jr., are co-operating in this enterprise, to whom gifts may also be sent, 11 West Twenty-ninth Street, New York.

British North Borneo.—The portion of Borneo ceded to the British North Borneo Company is of about the same size with Scotland, mountainous on the western side, and having large slopes and flats on the eastern side. Among the mountains is the Kina Balu, more than 13,900 feet high. Several rivers rise near the west coast, and, following a very long and winding course, fall into the sea on the east. The junction of several of these forms the Kina Batangau, a noble stream navigable by large steamers for 150 miles. On one of the tributaries of this river, the Quarmote, are the Alexander Falls, said to be a grand cataract, but never yet seen by any European. The rivers on the east coast run through an uninhabited virgin forest. On the west there is a fair population. From the healthfulness of its climate, the equableness and moderate heat of its temperature, the absence of physical disturbances, and the prodigious natural wealth with which it abounds, North Borneo promises to support a very large population. Ferocious wild animals are absent, while large game appears to be plenty. Valuable timber exists in great quantities, and is accessible; and, after the wood has been cleared off, the ground will be available for cultivation.

Philosophy of Combinations of Capital and Labor.—In an address before the Christian Conference which was held in Washington last December, ex-Mayor Low, of Brooklyn, held that the combinations of capital and labor, as represented by the corporation and the trades-union, are not necessarily antagonistic to one another, but are really different manifestations of the same force—the force which emphasizes the interdependence of society as against the individualizing forces of popular government. If the working on one side has resulted in wrong, it is equally the case on the other side; but the corporation is liable to the imputation that it is without sympathies and without a conscience. The workman is under the disadvantage that in the present minute division of labor his occupation has become almost wholly mechanical, and in case of the loss of his single function he has no resource. This belittling of the workmen's life has doubtless aggravated their sense of antagonism to capital. The same influences which have reduced the workingman in his daily scope have widened indescribably the privilege and opportunity of capital. Has capital appreciated as it should the responsibility and the duty which come with the privilege?

Mother-of-Pearl in the Red Sea.—The mother-of-pearl fisheries of the Red Sea extend the whole length of that water. About three hundred boats are employed by the Arab tribes who are engaged in the work—open, undecked boats, of from eight to twenty tons burden, carrying a large lateen sail, manned by crews of from five to twelve men, and each provided with a number of small canoes. There are two fishing seasons during the year, one of four and one of eight months, during nearly the whole of which the boats keep the sea. Fatal accidents are said to be unknown among the divers, and they are remarkable for their strength and good health. They dive between the ages of ten and forty years, and the practice is said to have no ill effects. Operations are conducted only in calm weather, when the shell can be discovered by the eye at a depth varying between seven and fifteen fathoms. Of late years, empty petroleum tins, with the ends knocked out and a sheet of glass inserted in one end, have been used to assist the eye. The glazed end of the tin is submerged under the sea, when a much clearer and deeper vision is obtained. During the last ten years the find is said to have diminished, owing to the dearth of shells, from ten to twenty per cent in quantity. Shells brought to Jeddah for sale are disposed of at public auction in heaps of about half a hundred-

weight each. As preliminary inspection is not allowed, the bidding is purely speculative. The bulk of the shells are now sent to Trieste, a small number to London, and a few to Havre; and some of the finest and largest shells are purchased for exportation to Bethlehem, where they are engraved and sold to pilgrims.

Games of the Greek Islanders.—Some of the games of the Greek islanders are described by Mr. J. Theodore Bent, in an article on "Greek Peasant Life," as wild, some as amusing, and some as distinctly traced to antiquity, "as probably all could if we had ample records to go upon." At Eastertime the maidens of many islands have the game of swing. They hang a rope from one wall of the narrow village street to the other. On this they put some clothes to form a seat, and two maidens seated side by side, facing in opposite directions, swing, and as they swing sing local ditties, plaintive for the most part, and in a high, shrill voice. The young men try to pass by, and are called upon for a toll of a copper apiece, a song, and a swing. They generally sing such words as these: "The gold is swung, the silver is swung, and swung, too, is my love with the golden hair." To which the maiden replies, "Who is it that swings me, that I may gild him with my favor, that I may work for him a fez all covered with pearls?" Having paid his copper, the youth is allowed to pass, and another comes by and does likewise. These games at Volathia, in Karpathos, take place on the Sundays in Lent, when the young men who are home from their work on this day can be present. "We are strongly reminded of the game of swing which the maidens of Athens played in remembrance of the death of Erigone, who hung herself from a tree, when they sang plaintive ditties in honor of her name and garlanded themselves with flowers, whereas now they sing solemn ditties about the passion and resurrection of our Lord. Among the games played by the boys of Samos, I saw one which bore a curious resemblance to single-wicket cricket. They call it 'ball,' *σφαῖρος*. There are five players on each side. One side is in; the other fields. The one who is in defends his wicket, a stone erected on the grass, with his hand. When he hits the ball he does not run, but counts one when the ball is sent beyond a certain boundary-line they have. If the ball hits the stone, he is out. In the mountain villages of Samos may still be traced in various forms the ancient game of *δακτύλου ἐπάλλαξις*, which we can see depicted on a vase for us in the Munich Museum. It exists still in Italy under the name of *morra*, but in its simplest form it has survived in Samos. We saw two little boys playing together. One leaned against a wall, head downward; the other placed his two fists one above the other on his playfellow's back. 'Which hand is uppermost?' he cried. The other guessed. 'No, it isn't,' was generally the reply, accompanied by a pretty smart smack. A more elaborate form of this game is when two boys, leap-frog fashion, stoop down, the foremost against the wall, and the hindermost helping him. A third boy leaps on the back of the one nearest to him, extends a certain number of fingers, and cries, 'How many fingers in the air?' The front boy has to guess, and if wrong receives a smack from the rider. Not only among boys is this a popular game, but *πόσα*, 'How many?' is a favorite game at village-feasts. Six men were playing it when I saw it, three on each side. The three on one side were called the beasts of burden, that is to say, they turned their backs to the other three, who jumped upon them. Having done this, one of the riders put one hand over the eyes of his 'beast of burden' and held the other in the air, and as he did so extended some fingers and closed others, and cried, *πόσα*, 'How many?' If the beast of burden is stupid in guessing the right number of fingers extended, he receives sundry boxes on the ears and general rough treatment from his rider amid the laughs and jeers of the bystanders. When all three beasts of burden have guessed aright, they change places with their riders, who have to guess in their turn."

Preparation for the End of the World.—Some of the people of Birmingham, England, conceived recently that the end of the world was at hand, and adopted various queer means to mitigate the effects of the dreaded event. Old women went to their Bibles,

and younger women to bed. Three women, failing to get the protection they sought from a policeman, clubbed their pennies to buy a Bible. Other persons, thinking that the world was to be set on fire by the collision of two stars, believed that it would be safest to avoid the streets. A story is told of an old nurse, on another occasion, who, imagining that a very heavy and dark thunder-storm meant the end of the world, went up-stairs and put on her best cap. In another thunder-storm, conveying a similar suggestion, a panic-stricken sufferer lamented that the parson was not at home. On the morning after a storm on the island of Sark, which nearly blew the house over, the old housekeeper addressed her master: "Eh! Mr. B——, did you hear the wind? Eh! I thought the day of judgment had come." "And what did you do?" the master asked. "Eh! Mr. B——, I got up and made myself a little cup o' tea."

Some Principles of Chemistry-Teaching.—A paper by Lillie J. Martin, of the High-School, Indianapolis, on "Chemistry in the High-School," contains some good thoughts on the subject of teaching the science. While historical study, rightly carried on, does not preclude work that gives the kind of discipline that science should give, and itself has many advantages, "the great danger is that the distinctive aims of science-study will be lost sight of in the historical study," as is alleged to be done in too many text-books. At the bottom of the author's system of teaching lies the principle that the peculiar discipline of chemistry-study comes through the proper use of the laboratory. In practice, she divides the time about equally between getting the facts, or laboratory-work, and considering the facts, or class-room work. Simple apparatus, made or adapted by the pupil, is pronounced the best; and her own description of the apparatus recommended shows how the most common things, some of them costing nothing, may be made to serve. Four kinds of experimental work are declared to be too much neglected in high-schools: work that teaches pupils the use of their senses; work that acquaints them with the underlying laws of the science; work that throws them on themselves, or independent qualitative analysis; and work that teaches scientific exactness, or quantitative work. Encouragement of pupils to do original work and write about it when they have done it is insisted upon. Many experiences have taught the author that even the best text-books should be preceded by work which would throw the pupils upon the use of their senses in learning their lessons. In her own teaching of laboratory-work, in order to save time, experiments to be done on a certain day are indicated the day before, and are learned by the pupil; and general directions as to the particular way of doing each experiment are given at the beginning of the experiment-hour. By a little encouragement pupils will do a good deal of extra experimental work, and much of this can be done at home, with great gain in independence and originality. The ability to write what is laid down in the text-book is not a sufficient test for promotion in chemistry. The "literary test" in examinations makes pupils feel that chemical information is the thing to strive for; and, to counteract this tendency, the author suggests, in a question, that high-school laboratories should be opened for a practical test during examination, to make pupils understand that a knowledge of chemistry means the ability to deal with Nature.

The Origin of "Manners."—Otto Goldmeister, in writing on the usages of politeness, treats the subject as a universal one, the adequate treatment of which would have to include all people, of all times and places, and of every degree of barbarism and civilization. An institution thus coextensive with mankind can not have originated in convention or the caprice of some small social groups, or have been the product of any particular period of time. The presumption is therefore justified that the social code of manners has some kind of a bearing on the development and welfare of the race, and that it contributes to some end that can not be so easily reached in any other way. The essence of courtesy consists in our using the outer signs of esteem toward a person whom we do not know or may inwardly despise, in order to place ourselves in a position in which we

may deal with him for the time being without inconvenience. In doing this, we regard the other person simply as a fellow-member of the human race, and say to him by implication: "The good elements of the race command my respect. I will presume that you belong to them, but I have at present no occasion to inquire whether that is so or not. I will act upon this presumption till the contrary is shown. Deal with me on the same principle." We must look for the origin of the outer manifestations of courtesy to the signals of peace manifest among savage tribes and rude men. As manners become ameliorated, what in the beginning meant "Your life is safe," comes to mean "You are welcome." Some of the manifestations may be traced directly back to gestures, or to attitudes showing the person using them to be unarmed. He stoops as if to drop his weapons; he holds up his empty hands; he crosses his arms upon his breast; he kneels, or he touches the ground with his forehead. From these come the "present arms" of the military service; from the taking off of the helmet came the opening of the visor of the old knights and the raising or touching the hat of the modern salutation; and possibly from the raising of the empty hands, the "shake-hands" gesture of the present time. The idea that we pay honor to another by standing in his presence is doubtless a survival from times when more scanty provision was made for seats than now, and the best place was given to the preferred person.

A Remarkable Specimen of Rock-Crystal.—Mr. George F. Kunz exhibited to the American Association some remarkably large specimens of rock-crystal from Ashe County, North Carolina. His attention was first called to the locality by receiving from there a fifty-one-pound fragment which was said to have been broken from a mass weighing three hundred pounds, by a mountain-girl twelve years old. Other specimens from farms in the same neighborhood were a remarkably clear twenty-pound half-distorted crystal, one weighing one hundred and eighty-eight pounds, and another—twenty-nine inches long, eighteen inches wide, and thirteen inches thick, showing one pyramidal termination perfect, and another partly so—weighing two hundred and eighty-five pounds. These localities are on a spur of the Phœnix Mountain, about fifty miles from Abingdon and forty miles from Marion, Virginia. The crystals were all found in disintegrated crystalline rocks, consisting principally of coarse feldspathic granite, which have all decomposed to a greater depth than their position. Most of them are obtained by digging where one crystal has been found, or by driving a plow till some hard object is struck. Several dozen have been found weighing from twenty to thirty pounds each. Some of these crystals afford larger masses of clear rock-crystal than have ever before been found in the United States, and suggest the use of that substance for such objects of luxury as crystal balls, clock-cases, mirrors, etc., of which examples may be seen in the Austrian Treasury at Vienna.

Origin of River-Swamps.—Prof. N. S. Shaler has observed, in studying the fresh-water swamps of New England, that those rivers which flow southwardly run in clear beds, through valleys that are free from swamps; while the valleys of all the rivers flowing to the north are swampy. The former rivers flow freely, the latter are sluggish. He believes that this condition may be accounted for as the result of successive movements or changes of level which took place during the Glacial period, or at and after its close, the succession having probably been as follows: 1. The subsidence of the land-surface under the weight of the ice to a depth below the level of the sea; 2. With the retreat of the ice, a re-elevation, in a sudden manner, to a height above the level of the sea; and, 3. With the disappearance of the ice from the continent, a readjustment of its position and a consequent lowering of the southern portion of the glaciated area. It is not likely that in the readjusted condition of the continent all parts are equally elevated or equally lowered. The present levels of the several divisions of the continental area would probably be determined by complicated equations of thrusts, and it is probable that in this way we may explain the fact that certain of the lesser valleys of New England show little effect from the tilting movement

which in immediately contiguous areas has had a great influence in the flow of the streams. The author observes that the facts upon which his conclusion is founded throw much light upon the pre-glacial attitude of the continent. These river-valleys retain the general form which they had before the last glacial ice began to act upon them, and they pursue their present courses because their flow is mainly determined by the existence of the pre-glacial river-valleys in which they lie. It is clear that these valleys could not have been excavated by streams of their present slope; it seems, therefore, necessary to assume that the descent of the northward-flowing rivers must have been more rapid in the pre-glacial times than it is at present, or, in other words, that this part of the continent was at that time relatively less elevated in its northern parts than it is now.

Products of the Cowles Electric Furnace.—In the American Association, Professor C. F. Mayberry gave some additional information to that which he had previously communicated concerning the aluminum products from the Cowles electrical furnace. The efficacy of charcoal in promoting an intense heat (see "Monthly" for November, 1885) had been increased by coating it with lime; and the quantity of the product was augmented by modifying the direction in which the electrodes were introduced. Some erroneous statements by foreign electricians were referred to. Among them was a remark by Dr. Martins that they did not need to be informed by Americans concerning aluminum or its alloys. No direct answer was made to this, but the tenor of the facts cited by Professor Mayberry was to the effect that that was a subject on which they had still room to be informed.

Chinese Grass-Cloth.—The fabric known as Chinese grass-cloth is made from the fiber of nettles (*Boehmeria nivea* and other species) which are cultivated in China, and grow in India and Ceylon. They are perennial, herbaceous plants, having broad oval leaves with a white down on the under sides, and are stingless. The fiber is worked with much skill in China, but no important manufacture of it has been developed in India. The Indian Government some time ago offered a reward for an economical method of preparing the fiber, and the want has been partly filled by two French inventions, by one of which the stems of the nettles are decorticated and freed from glutinous matter by steam-treatment, and by the other the fibers are converted into a tow ready for spinning. The cloth manufactured from this fiber is glossy, has a peculiar transparency, and is of beautiful texture; and, as belting for machinery, has double the strength of leather belting.

NOTES.

THE many American friends of Mr. Herbert Spencer have frequently been pained during the past two years by the very discouraging reports concerning the state of his health, and the fear has been expressed that he would be unable to do any more work. We take much pleasure in stating, on the authority of a private letter from an intimate friend of Mr. Spencer, that there has been an improvement in his condition so great that the writer characterizes it as a "wonderful restoration to health."

THE most extensive forest plantations in the United States mentioned in the "Report" of the Division of Forestry are those of the Fort Scott and Gulf Railroad, and of Mr. Hunnewell, near Farlington, Kansas, of about 640 acres each, Mr. Burnett Landreth's plantation, of 300 acres, in Virginia; those of the Messrs. Fay and others, along the sea-coast of New England; and some of considerable extent in southern California. Small groves abound in the prairie States, and are found less frequently in the Eastern States, notably in New England. In the aggregate these plantations must amount to a considerable area. Forest commissions or bureaus have been instituted in New York, California, Ohio, and Colorado.

THE nomenclature adopted by the International Geological Congress to express the taxonomic rank of stratigraphic or chronologic divisions is thus summarized by Mr. G. K. Gilbert in his address before Section E of the American Association: Of stratigraphic divisions, that with the highest rank is *group*, then *system*, then *stage*. The corresponding chronologic divisions are *era*, *period*, *epoch*, and *age*. The word *formation* is restricted to the special function of designating mineral masses with reference to their origin. No word having been suggested in its place to denote indefinitely an aggregate of strata, Mr. Gilbert proposes *terrane*, and, for the corresponding chronologic term, *time*.

Of eighty-eight species of weeds described by Mr. L. H. Pammel, of St. Louis, as growing in southwestern Wisconsin and southeastern Missouri, forty-six are of European and thirty of American origin. One third of the latter class, and nearly one fourth of the entire list, are composites.

Pathologists have believed for many years that the material cause for intermittent fever is generated in the soil, and acts through the air. The discovery by Tommasi-Crudelli and Klebs, in malarial soil, of a bacillus capable of producing febrile symptoms was competent to illustrate the agency of the soil in the matter, but did not pursue the malarious influence into the atmosphere. The last has now been done by Professor Schiavuzzi, of Pola, who has obtained a bacillus from the atmosphere, indistinguishable in structure from that of Tommasi-Crudelli, which also produces in animals the characteristic symptoms and pathological changes belonging to ague.

There is an orange-tree in the gardens of the Palace of Versailles that is more than four hundred and fifty years old. It is called the Grand Constable, and was planted at Pampeluna, about 1416, by Eleanor of Castile, Queen of Charles III of Navarre. It was transplanted to Chantilly and Fontainebleau, and finally to Versailles in 1684.

A new system of sewage works has been put into operation at Henley-on-Thames, England. Its object is to avoid the discharge of the sewage into the river—which can no longer be allowed—and lift it to a level which will permit it to be used for irrigation. Ejectors are placed in different parts of the town to receive the sewage, and from there it is forced by compressed air into tanks about a mile distant, and 180 feet higher in elevation. The method is not costly, it is proved practicable, and it may offer a successful solution of the question of the disposal of the sewage of low-lying towns.

The English Home Secretary, recognizing corporal punishment as a fact, is giving attention to means of regulating it according to the physical condition of the child, so that it shall not bear too hard upon the weak. It is proposed to make the weight of the rod bear some proportion to the age of the child, and to permit the interposition of a medical veto in case of evident weakness.

A considerable extension of long-distance telephoning was effected during 1887. At the close of the year twenty-five circuits were at work between New York and Philadelphia, the chief points in Connecticut had been connected, and lines were projected to Worcester, Boston, Albany, and Washington.

An argument against allowing children to drink milk in the summer-time is drawn by Dr. V. C. Vaughn, of the University of Michigan, from the liability of the fluid to develop the poison—tyrotoxicon—which is supposed to be the immediate cause of summer diarrhœa.

Professors Lachinof and Jerofeief have found in a meteoric stone which fell at Krasnoslobodsk, Russia, in September, 1886, corpuscles possessing the principal characteristics of the diamond, in such quantity as to compose one per cent of the stone. Taken with the facts that amorphous graphitic carbon is a known constituent of meteoric irons and stones, and that crystals of graphitic carbon have been found in the meteoric iron from Western Australia, this observation may throw some light on the manner in which diamonds are formed.

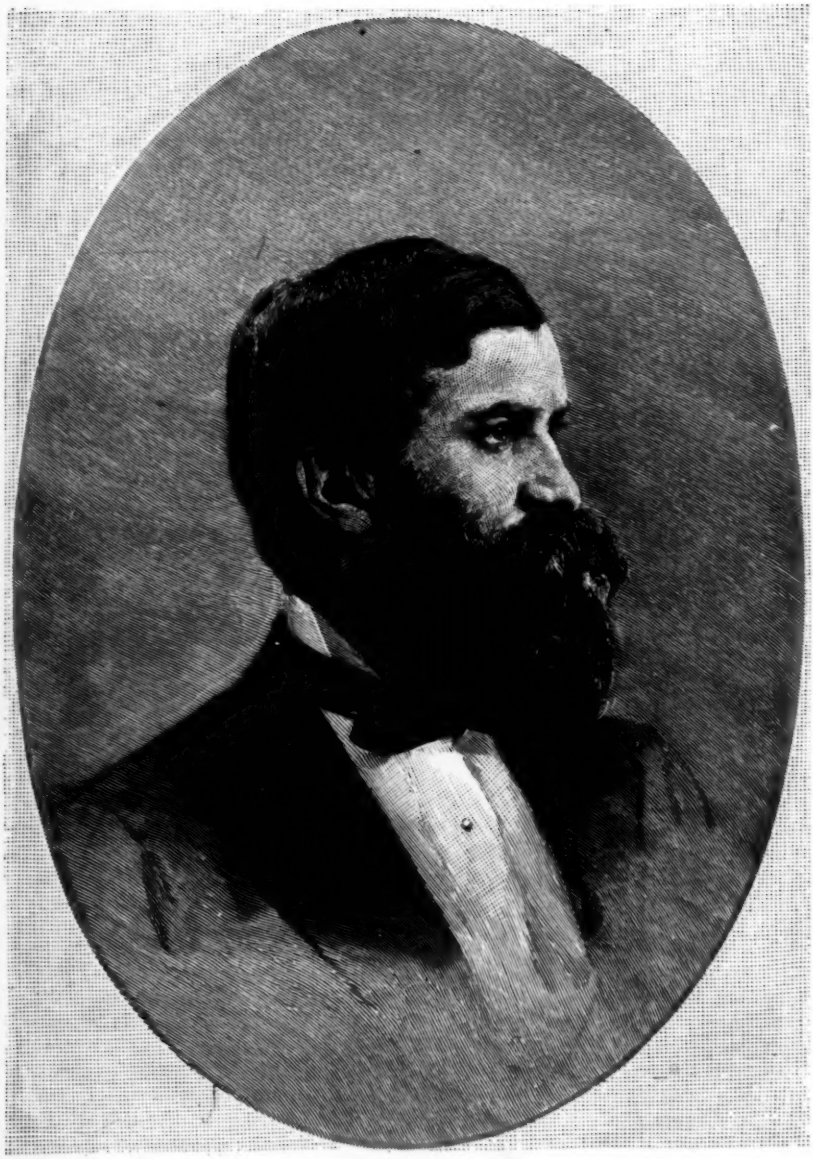
The much despised agricultural laborer, says the Earl of Derby, who has learned to watch and understand the signs of the weather, to be knowing about stock, and who can use his hands skillfully, though he might be backward in book-learning, is quite as well instructed in any worthy sense as the prize prig stuffed with scraps of miscellaneous information, but knowing little at first hand, unaccustomed to observe, ignorant of animals, trees, flowers, or country life, and unskilled in any craft or in the handling of any tool.

Dr. A. Richardson has found that at 500° C. nitrogen peroxide is decomposed into nitric oxide and oxygen, the gas becoming nearly colorless.

The theory that the increased brittleness of human bones with advancing years is the result of an increased percentage of inorganic salts, is contradicted by the experiments of Mr. Mason. From determinations of the ash in bones of fifty subjects of different ages, he has found that after reaching manhood no variation in the quantity of ash takes place with increasing age.

OBITUARY NOTE.

Prof. William D. Gunning, lecturer and writer on scientific subjects, died at Greeley, Col., March 8th, in the fifty-eighth year of his age. He was born in Bloomingburg, Ohio, in 1830, was graduated from Oberlin College, studied in comparative anatomy in New York and in biology with Prof Agassiz, held lectureships in geology at Hillsdale College, Mich., and in Pittsburg, and was the author of a "Life History of Our Planet." He was also a contributor to "The Index" and to "The Open Court," and at the time of his death had been engaged as the pastor of the Unitarian Society in Greeley.



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